NOTICE

All drawings located at the end of the document.

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

This RSOP Notification for Facility Disposition addresses leaving Corridor A (north-south tunnel) and Vault 998 in place as final disposition of these structures. Also included is Corridor B and Room 402. As discussed in Section 4 of the RSOP for Facility Disposition, tunnels will be addressed on a case-by-case basis. This notification discusses the physical condition of the tunnel, vault, remaining corridor portion and Room 402 along with the pre-demolition survey (PDS) results and environmental, structural, and groundwater analyses that have been conducted. The final section discusses the proposal for final disposition.

PHYSICAL DESCRIPTION

The following information is from the Building 991 Complex Facility Safety Analysis Report (FSAR), October 2001, the current Land Configuration plans, and original building drawings.

The 991 Corridor A is an underground, reinforced concrete structure connecting B991 to Vault 998. The tunnel is 7 feet six inches wide and 180 feet long. The walls, roof and floor of the tunnel are 15 inches thick. The earth cover is estimated at a maximum of 18 feet.

Vault 998 (also known as Room 300) is located north of B991. The room has exterior dimensions of approximately 30 feet by 20 feet with two feet six inch thick reinforced concrete walls, floor, and roof. The earth cover over Vault 998 is up to 14 feet in depth.

Corridor B is the y-shaped underground corridor that connects B991 north and west to Corridor C (the east-west tunnel that is foamed). The west leg of the corridor is 12 feet wide and the east leg is 8 feet wide. The height varies as the two legs of the corridor are, in effect, a ramp up the floor level of Building. The ceiling height starts at 12 feet six inches high at grade level and ramps to just over 9 feet high at the 991 floor level. Walls and ceiling are 15 inches thick just as Corridor's A and C. The earth cover currently over Corridor varies from 6 feet to 8 feet.

Room 402 is situated in between the two legs of Corridor B and is not part of B991. It actually consists of four rooms or voids, one being Room 402 which held the supply plenum and static pressure controllers for the exhaust fans for Corridor C and Vaults 996, 997, and 999. That room is rectangular in shape with the northeast corner cut at a 45° angle. The west wall is 19 feet four inches, the south wall is 27 feet long, and the north wall is approximately 18 feet. A small triangular is to the east of Room 402 which was actually the air inlet for the supply plenum located in Room 402. The triangular room is 10 feet x 10 feet on the equal walls. Another void on the north side of Room 402 was actually a chase for piping and ducting that went to Building 985 built over the top of Corridor B. That void, accessible only by a small inspection door, 3 feet x 3 feet, was 6 feet x 6 feet and extended all the way up through the floor of Building 985. All piping and ducting has been removed from that chase and it has been filled with granular soil all the way to the surface. The fourth void is to the east of the chase and is not accessible. The west wall is 6 feet, the south wall approximately 10 feet, and the north wall approximately 4 feet. The east wall is a continuation of the wall that east wall of the air inlet and the northeast wall of Room 402. The ceiling over the entire area is 15 inches thick. Earth cover over Room 402 and its auxiliary rooms is 6 feet to 8 feet.

PDS RESULTS

The PDS Report will present the survey results from the 991 Building, including Corridor A, Vault 998, Corridor B, Room 402 and the building itself. This report is expected to be submitted to the CDPHE in February; however, results from Corridor A and Vault 998 have been presented to CDPHE on January 7, 2004 (Attachment 1). These results show that Corridor A and Vault 998

Reviewed for Classification/OUO/UCNI
By: Janet Nesheim, Derivative Classifier
DOE, EMCBC
Date: 10-15-08
Confirmed Unclassified, Not UCNI/Not OUO

DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE

RECEIVED

115

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

meet the unrestricted release criteria. The PDS for Corridor B and Room 402 has just been completed and also shows that these areas meet unrestricted release criteria (Attachment 1A). The PDS is underway for the remainder of the building and will be presented to CDPHE as it becomes available.

ENVIRONMENTAL ANALYSIS

These structures are part IHSS Group 900-1, 991 UBC. Samples were collected in accordance with SAP Addendum IA-03-03 to determine if contamination existed below these structures. No contamination was found that required an action. These data were presented to EPA and CDPHE on January 7, 2004. Based on the data collected and presented there is not an exceedance that would result in an ER action at Corridor A, Vault 998, Corridor B or Room 402 (Attachment 2). The data will be included in the IHSS Group 900-1 Closure Document (under development).

STRUCTURAL ANALYSIS

In December 2003/January 2004, a structural analysis was conducted for the 991 Corridor A tunnel and the 998 vault to predict the long-term condition of these structures if they were left in place. The analysis assumed the footing drains fail, allowing groundwater to enter the structures and corrode the steel rebar in the concrete. The conservative engineering estimate was that the 991 Corridor A tunnel could continue to exist without failing for 1000 years or longer (Attachment 3). Corridor B and Room 402 having dimensional configuration similar to Corridor C is expected to exist without failing for 500 years or longer (Attachment 3A).

GROUNDWATER ANALYSIS

Groundwater modeling was conducted for these structures in December 2003 (Attachment 4). This analysis assumed more conservative wet conditions and a smaller grid size. The modeling parameters were the same that were used for the 771 DOP and the previous 991 tunnel and included the current Land Configuration plans for the 991 area.

Under wet conditions, the model predicts no adverse impact (i.e., groundwater is greater than 3 meters from the surface) all along Corridor A, Vault 998, Corridor B and Room 402. Further, the model shows no contaminated plumes migrating into the tunnel area during these wet conditions.

DISPOSITION PROPOSAL

Based on these results, final disposition of the Corridor A tunnel and the 998 vault, Corridor B tunnel, and Room 402 is proposed to include the following:

- All structures remain in place.
- The tunnel, vault, corridor and room are emptied.
- All ductwork, conduit, lighting, and asbestos insulated air and water lines are removed.
- Floor tiles and painted surfaces will remain.
- The footing drain will not be interrupted and will remain in place. However, no efforts will be made to maintain the drain.
- A twelve-foot thick plug of foam will be placed approximately 60 feet from the entrance to the 991 Corridor A tunnel.
- An eighteen-foot thick plug of foam will be placed in Corridor B in front of the roll-up door at the west entrance and an eight to ten foot thick plug of foam will be placed at the east double door entrance leading into Building 991.

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

- Room 402 will be filled with foam to a level of 6 feet. Additionally the door way will be plugged with an eight x ten-foot thick plug of foam extending a minimum of 2 feet above the door. The air inlet holes through the south wall of the air inlet room will also be filled with foam. The 6 feet of foam in Room 402 will not extend into the air inlet room or other cavities described above.

During demolition of the remainder of the 991 Complex, final grading will cover the foam plugs. Based on the current Land Configuration plans the plugs in Corridor B and Room 402 will be approximately seven to fourteen-feet below and one hundred-feet horizontally from the final grade. The tunnel and 998 vault will be, on average, approximately four to six feet below grade with the shallowest depth at 4 feet at the area of foam installation for Corridor A and the deepest depth at thirteen feet at the 998 vault.

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 1
PDS Results for Corridor A and Vault 998

4

SURVEY UNIT 991-2-004
RADIOLOGICAL DATA SUMMARY - PDS

Survey Unit Description: B991 East Tunnel and B998 Vault

5

Total Surface Activity Measurements

16	17
Number Required	Number Obtained

MIN	-11.0	dpm/100 cm^2
MAX	21.9	dpm/100 cm^2
MEAN	4.3	dpm/100 cm^2
STD DEV	9.5	dpm/100 cm^2
TRANSURANIC $DCGL_W$	100	dpm/100 cm^2

Removable Activity Measurements

16	17
Number Required	Number Obtained

MIN	-1.6	dpm/100 cm^2
MAX	6.4	dpm/100 cm^2
MEAN	0.0	dpm/100 cm^2
STD DEV	2.3	dpm/100 cm^2
TRANSURANIC $DCGL_W$	20	dpm/100 cm^2

6

SURVEY UNIT 991-2-004
TSA - DATA SUMMARY

Manufacturer:	NE Tech	NE Tech	NE Tech	NE Tech
Model:	DP-6	DP-6	DP-6	DP-6
Instrument ID#:	1	2	3	4
Serial #:	3113	2352	1249	1420
Cal Due Date:	2/22/04	5/11/04	4/02.04	5/19/04
Analysis Date:	12/9/03	12/9/03	12/9/03	12/9/03
Alpha Eff. (c/d):	0.224	0.230	0.199	0.222
Alpha Bkgd (cpm)	0.0	1.0	3.0	0.0
Sample Time (min)	1.5	1.5	1.5	1.5
LAB Time (min)	1.5	1.5	1.5	1.5
MDC (dpm/100cm^2)	0.0	31.6	63.2	0.0

Sample Location Number	Instrument ID#:	Sample Gross Counts (cpm)	Sample Gross Activity (dpm/100cm2)	LAB Gross Counts (cpm)	LAB Gross Activity (dpm/100cm2)	Sample Net Activity (dpm/100cm2)[1]
1	2	6.7	29.1	4.7	20.4	18.2
2	2	2.7	11.7	2.0	8.7	0.8
3	4	0.7	3.2	0.7	3.2	-7.8
4	4	7.3	32.9	1.3	5.9	21.9
5	4	2.7	12.2	1.3	5.9	1.2
6	2	3.3	14.3	2.0	8.7	3.4
7	2	5.3	23.0	3.3	14.3	12.1
8	2	3.3	14.3	3.3	14.3	3.4
9	4	3.3	14.9	1.3	5.9	3.9
10	4	5.3	23.9	3.3	14.9	12.9
11	4	0.7	3.2	2.0	9.0	-7.8
12	4	4.0	18.0	1.3	5.9	7.0
13	4	1.3	5.9	3.4	15.3	-5.1
14	4	6.0	27.0	2.7	12.2	16.1
15	4	3.3	14.9	0.7	3.2	3.9
16	4	0.0	0.0	4.0	18.0	-11.0
17	1	109.0	486.6	4.7	21.0	0.0
					11.0	Sample LAB Average
					MIN	-11.0
					MAX	21.9
					MEAN	4.3
					SD	9.5
					Transuranic DCGL$_W$	100

1 - Average LAB used to subtract from Gross Sample Activity

2 -The initial Sample Net Activity for location 17 was 475.6 dpm/100cm^2. A coupon sample was collected from location 17 and analyzed using the Canberra ISOCS system. No transuranic isotopes were detected. The sample activity was determined to be from uranium and naturally occuring isotopes. The Sample Net Activity for this location is below the uranium DCGL$_W$ limits (5000 dpm/100cm2). All survey results are less than the applicable DCGLs, therefore, no further investigation is required. On this basis, the transuranic value for location 17 is reported as zero (0) net activity in the TSA Data Summary.

QC Measurements

14 QC	3	6.0	30.2	0.0	0.0	20.1
15 QC	3	4.0	20.1	4.0	20.1	10.1
					10.1	QC LAB Average
					MIN	10.1
					MAX	20.1
					MEAN	15.1
					Transuranic DCGL$_W$	100

1 - Average QC LAB used to subtract from Gross Sample Activity

7

SURVEY UNIT 991-2-004
RSC - DATA SUMMARY

Manufacturer:	Eberline	Eberline	Eberline	Eberline
Model:	SAC-4	SAC-4	SAC-4	SAC-4
Instrument ID#:	5	6	7	8
Serial #:	952	966	952	966
Cal Due Date:	1/10/04	4/23/04	1/10/04	4/23/04
Analysis Date:	12/9/03	12/9/03	12/9/03	12/9/03
Alpha Eff. (c/d):	0.33	0.33	0.33	0.33
Alpha Bkgd (cpm)	0.4	0.2	0.4	0.2
Sample Time (min)	2	2	2	2
Bkgd Time (min)	10	10	10	10
MDC (dpm/100cm^2)	9.3	9.0	9.0	9.0

Sample Location Number	Instrument ID#	Gross Counts (cpm)	Net Activity (dpm/100 cm^2)
1	5	0.0	-1.6
2	6	0.0	-0.8
3	5	0.0	-1.6
4	6	0.0	-0.8
5	5	1.0	2.4
6	6	0.0	-0.8
7	5	0.0	-1.6
8	6	0.0	-0.8
9	5	1.0	2.4
10	6	0.0	-0.8
11	5	0.0	-1.6
12	6	1.0	3.2
13	5	0.0	-1.6
14	6	0.0	-0.8
15	5	0.0	-1.6
15	6	0.0	-0.8
17	5	2.0	6.4
		MIN	-1.6
		MAX	6.4
		MEAN	0.0
		SD	2.3
		Transuranic DCGL$_W$	20

9

991-2-004
Media Conversion Sheet

LOCATION DESCRIPTION	SAMPLE LOCATION NUMBER	SITE SAMPLE ID	NUCLIDE	pCi/g (2)	MDA (pCi/g)	WEIGHT (g)	SURFACE AREA (in^2)	INDIVIDUAL NUCLIDE (dpm/100cm^2) (3)	ESTIMATED MDA (dpm/100cm^2) (4)	URANIUM TOTAL (dpm/100cm^2)	TRANSURANIC TOTAL (dpm/100cm^2)
B998	17	03S0205-016.001	U-234	33.000	45.400	25.8	24.5	1196	1645		
			U-235	0.956	0.201			35	7		
			U-238	0.889	0.778			32	28	1262.6	
			Pu-239 Pu-240	0.000	1.296			0	47		
			Am-241	0.000	0.180			0	7		0.0

CANBERRA


```
*************************************************************************
*****        G A M M A   S P E C T R U M   A N A L Y S I S          *****
**  C a n b e r r a  M o b i l e  L a b o r a t o r y  S e r v i c e s **
*************************************************************************
```

991-2-004

8998 Vault

Location #17

Report Generated On	:	12/11/2003 11:39:29 AM
RIN Number	:	04S0097
Analytical Batch ID	:	0312104606
Line Item Code	:	RC10C019

Filename: S:\GENIE2K\CAMFILES\LI014(G)\MOD\G1900116.CNF

Sample Number	:	04S0097-003.001
Lab Sample Number	:	CMLS-4214
Sample Receipt Date	:	12/10/2003
Sample Volume Received	:	2.58E+001 GRAM
Result Identifier	:	NA
Peak Locate Threshold	:	2.50
Peak Locate Range (in channels)	:	100 - 8192
Peak Area Range (in channels)	:	100 - 8192
Identification Energy Tolerance	:	1.000 keV
Sample (Final Aliquot Size)	:	2.580E+001 GRAM
Sample Quantity Error	:	0.000E+000
Systematic Error Applied	:	0.000E+000
Sample Taken On	:	12/9/2003 2:30:00 PM
Acquisition Started	:	12/11/2003 7:34:50 AM
Count Time	:	7200.0 seconds
Real Time	:	7231.1 seconds
Dead Time	:	0.43 %

Energy Calibration Used Done On : 10/1/03

Energy = 0.263 + 0.250*ch + 2.24E-009*ch^2 + 0.00E+000*ch^3

Corrections Applied:

None

Efficiency Calibration Used Done On : 12/11/03

Efficiency Geometry ID : 04S0097-003.001

Analyzed By: Phil Sanderson Date: 12/11/03

Reviewed By: Marilyn Umbaugh Date: 12/11/03

10

****

***** Sample and QC Sample Results Summary *****

****

Site Sample ID : 04S0097-003.001

Analytical Batch ID : 0312104606

Sample Type (Result Identifier): G19

Lab Sample Number : CMLS-4214

Geometry ID : 04S0097-003.001

Filename: S:\GENIE2K\CAMFILES\LI014(G)\MOD\G1900116.CNF

Detector Name: 4606

MDA = Curie method as specified in Genie-2000 Customization Tools Manual Appendix B; Basic Algorithms.

Analyte	Activity (pCi/GRAM)	2-Sigma Uncertainty (pCi/GRAM)	MDA (pCi/GRAM)
K-40n	1.14E+001	2.33E+000	2.74E+000
CS-137n	0.00E+000	0.00E+000	2.87E-001
TL-208n	2.09E-001	6.70E-002	1.38E-001
PO-210in	0.00E+000	0.00E+000	2.56E+004
BI-212n	0.00E+000	0.00E+000	3.82E+000
PB-212n	3.98E-001	9.49E-002	1.88E-001
BI-214n	8.78E-001	1.92E-001	3.55E-001
PB-214n	7.24E-001	1.87E-001	4.99E-001
RA-226n	0.00E+000	0.00E+000	3.24E+000
AC-228n	0.00E+000	0.00E+000	1.21E+000
TH-230n	0.00E+000	0.00E+000	1.78E+001
Th-231n	4.98E-001	3.90E-001	6.82E-001
PA-234Mn	0.00E+000	0.00E+000	3.42E+001
PA-234n	0.00E+000	0.00E+000	2.95E-001
U-234n	3.30E+001	1.54E+001	4.54E+001
U-235	9.56E-001	2.36E-001	2.01E-001
U238	8.89E-001	4.63E-001	7.78E-001
AM-241	0.00E+000	0.00E+000	1.80E-001

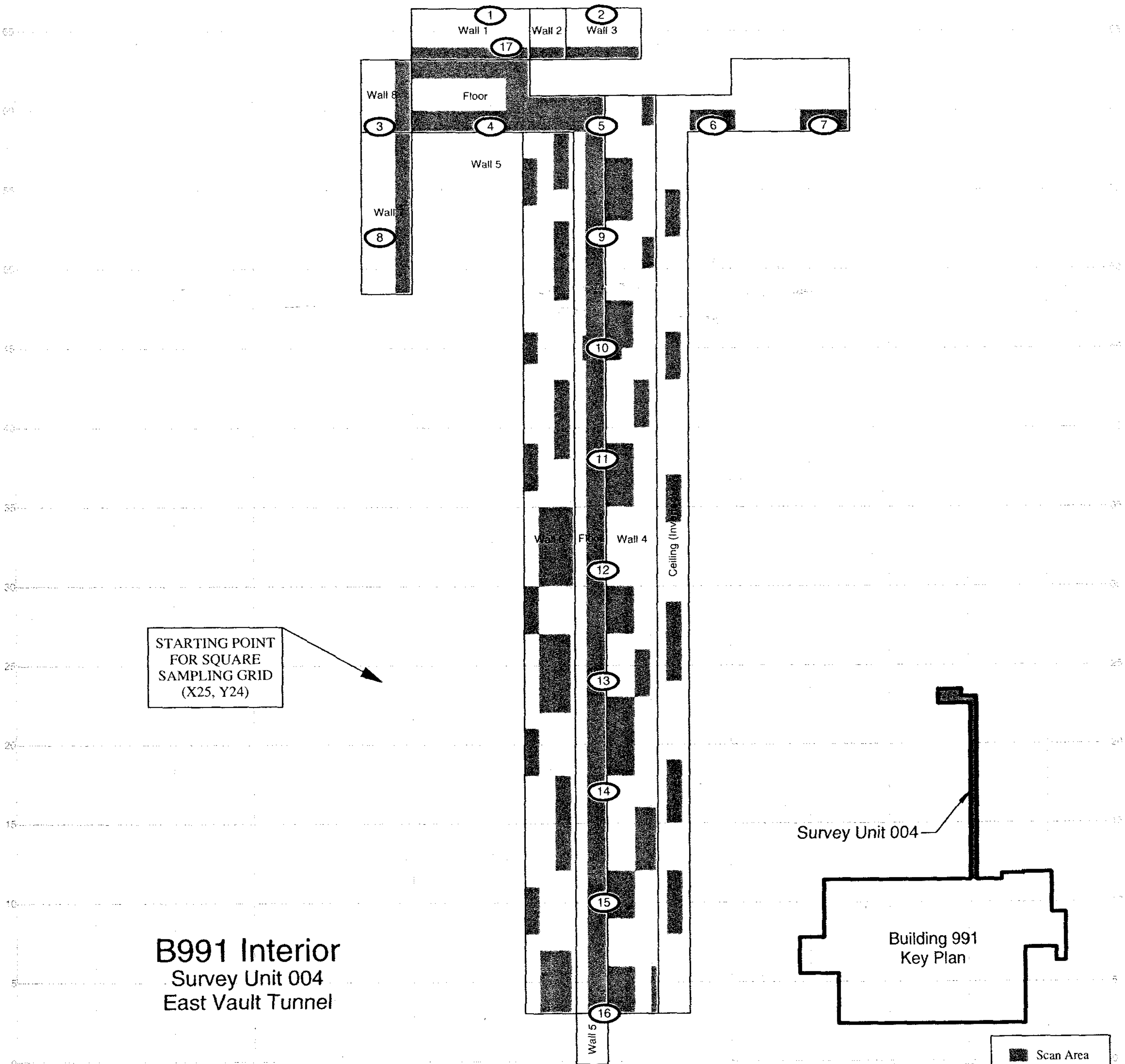
i - If Po-210 is detected in the spectrum, this peak may be the result of the interaction of Pb-206(n,n') which also produces a prompt gamma at 803 keV.

n - Non-contractual Nuclide

//

PRE-DEMOLITION SURVEY FOR AREA 2, GROUP 2

Survey Area: 2 **Survey Unit:** 991-2-004 **Classification:** 2
Building: 991
Survey Unit Description: B991 East Vault Tunnel
Total Area: 774 sq. m. **Floor Area:** 155 sq. m.
Grid Spacing for Survey Points: 7m X 7m



SURVEY MAP LEGEND
- Smear & TSA Location
- Smear, TSA & Sample Location
- Open/Inaccessible Area
- Area in Another Survey Unit

Neither the United States Government, nor Kaiser Hill Co., nor CH2M Hill, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

N

0 FEET 40
0 METERS 10
1 inch = 30 feet 1 grid sq. = 1 sq. m.

Scan Survey Information
Survey Instrument ID #(s) & RCT ID #(s):
1, 2, 3 & 4

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: GIS Dept. 303-966-7707
Prepared for:

CH2MHILL Communications Group
KAISER HILL

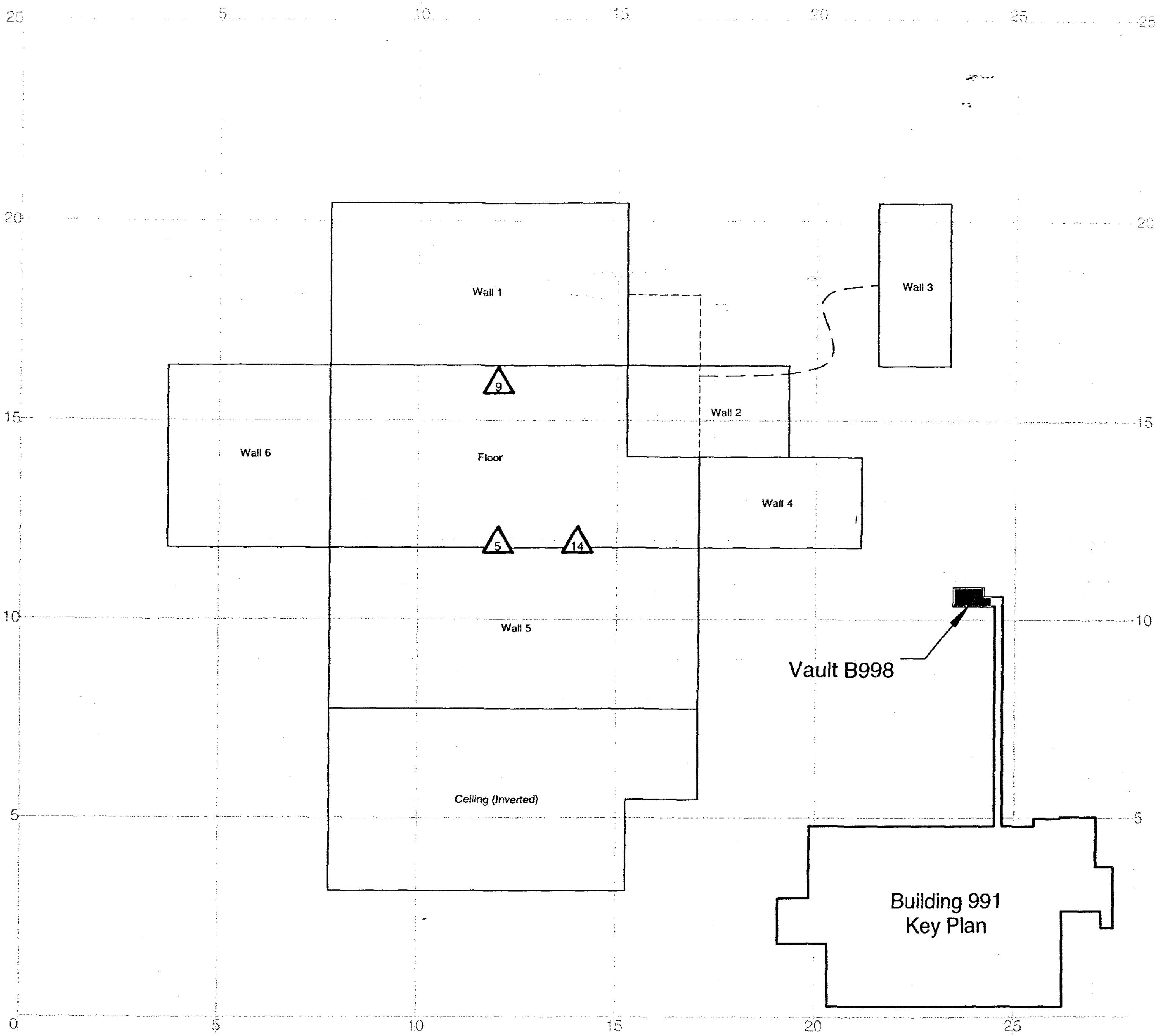
MAP ID: 03-JS/991-004-SC
July 22, 2003

12

CHEMICAL SAMPLE MAP

B991 East Tunnel & Vault
Floor Area = 155 sq. m = 1,670 sq. ft.
No. of SU Random Samples = 14

Vault B998



SURVEY MAP LEGEND

- Asbestos Sample Location
- Beryllium Sample Location
- Lead Sample Location
- RCRA/CERCLA Sample Location
- PCB Sample Location

Neither the United States Government, nor Kaiser Hill Co., nor CH2M Hill, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

N

0 FEET 15
0 METERS 5

1 inch = 12 feet 1 grid sq. = 1 sq. m.

B998 Interior
Survey Unit 991-003-Be

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: GIS Dept. 303-966-7707
Prepared for:

CH2MHILL Communications Group

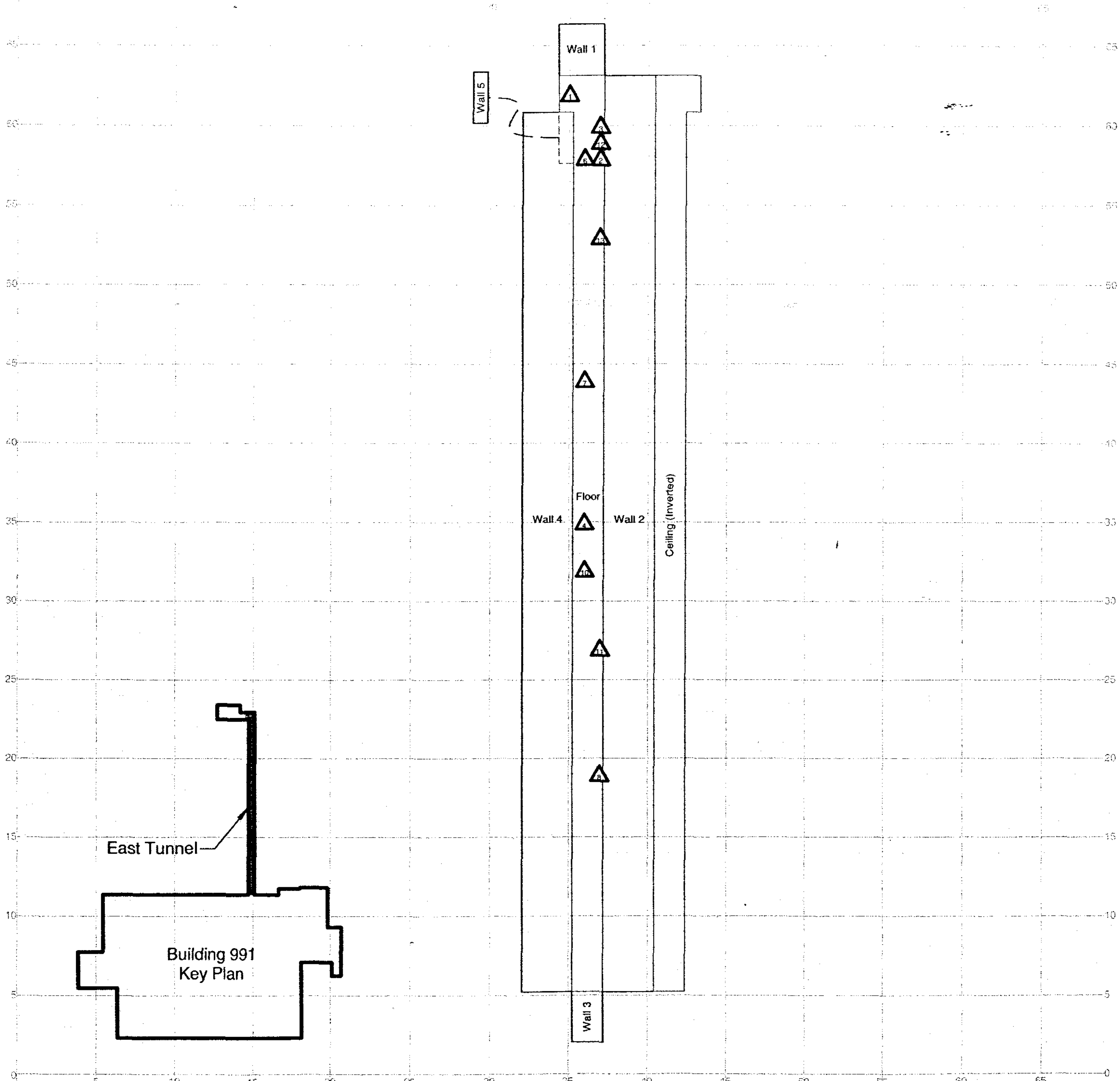
KAISER HILL COMPANY

MAP ID: 03-JS/991004BE1
Jan 5, 2004

CHEMICAL SAMPLE MAP

B991 East Tunnel & Vault
Floor Area = 155 sq. m = 1,670 sq. ft.
No. of SU Random Samples = 14

East Tunnel



SURVEY MAP LEGEND

- Asbestos Sample Location
- Beryllium Sample Location
- Lead Sample Location
- RCRA/CERCLA Sample Location
- PCB Sample Location
- Open/Inaccessible Area
- Area in Another Survey Unit

Neither the United States Government, nor Kaiser Hill Co., nor CH2M Hill, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

N

0 FEET 40

0 METERS 10

1 inch = 30 feet 1 grid sq. = 1 sq. m.

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: GIS Dept. 303-966-7707

Prepared for:

CH2MHILL
Communications Group

KAISER HILL COMPANY

MAP ID: 03-JS/991004-BE2

Jan. 5, 2004

15

December 18, 2003

Laboratory Report ID 03121702
Laboratory Name: Johns Manville IH Lab
Subcontract Number: KH020005
RIN: 04Z0600
Requestor: Mark Simpson
P.O./Charge Code: EFD991DX

QUICK RESULTS SUMMARY

Customer Number	Laboratory ID Number	Requested Analysis	Reporting Limit	CONCENTRATION			Q	Air Vol or Time	Air Concentration
				Back Section	Front Section	Total			
991-12162003-23-001	03121702-001	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-002	03121702-002	Beryllium	0.1 µg			< 0.1 µg	J		
991-12162003-23-003	03121702-003	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-004	03121702-004	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-005	03121702-005	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-006	03121702-006	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-007	03121702-007	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-008	03121702-008	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-009	03121702-009	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-010	03121702-010	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-011	03121702-011	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-012	03121702-012	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-013	03121702-013	Beryllium	0.1 µg			< 0.1 µg	U		
991-12162003-23-014	03121702-014	Beryllium	0.1 µg			< 0.1 µg	U		
991-12112003-23-501	03121702-015	Beryllium	0.02 µg			< 0.02 µg	U		
991-12102003-23-501	03121702-016	Beryllium	0.02 µg			< 0.02 µg	U		
991-12152003-23-501	03121702-017	Beryllium	0.02 µg			< 0.02 µg	U		
991-12152003-23-502	03121702-018	Beryllium	0.02 µg			< 0.02 µg	U		

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

INSTRUMENT DATA

Mfg.	Eberline	Mfg.	Eberline	Mfg.	N/A
Model	SAC-4	Model	SAC-4	Model	
Serial #	1158	Serial #	1164	Serial #	
Cal Due	1/1/04	Cal Due	1/30/04	Cal Due	
Bkg	0 cpmα	Bkg	0 cpmα	Bkg	cpmα
Efficiency	33.00 %	Efficiency	33.00 %	Efficiency	%
MDA	20 dpmα	MDA	20 dpmα	MDA	N/A dpmα
Mfg.	Eberline	Mfg.	Eberline	Mfg.	N/A
Model	BC-4	Model	BC-4	Model	
Serial #	835	Serial #	700	Serial #	
Cal Due	9/19/04	Cal Due	12/19/03	Cal Due	
Bkg	37.7 cpmβ	Bkg	35.4 cpmβ	Bkg	cpmβ
Efficiency	25.00 %	Efficiency	25.00 %	Efficiency	%
MDA	200 dpmβ	MDA	200 dpmβ	MDA	N/A dpmβ

Survey Type: Contmination

Building: B991

Location: Overhead and East Tunnel Ducts

Purpose: Swipes going to Offsite Lab

RWP #: N/A

Date: 10/6/03 **Time:** 0830

RCT: Bowman / Johnston Leo Bowman / [redacted]

Print name / Signature / Emp. #

RCT: N/A / / N/A

Print name / Signature / Emp. #

PRN/REN # : 021113-T130C-013

Comments: COC RIN# 042 0050
991 East hallway and over head samples

SURVEY RESULTS

Swipe #	Location / Description Results in DPM/100sq.cm	Removable Alpha	Removable Beta	Total Alpha	Total Beta
1	991-10062003-23-1	<20	<200	<94	<5K
2	991-10062003-23-2	<20	<200	<94	<5K
3	991-10062003-23-3	<20	<200	<94	<5K
4	991-10062003-23-4	<20	<200	<94	<5K
5	991-10062003-23-5	<20	<200	<94	<5K
6	991-10062003-23-6	<20	<200	<94	<5K
7	991-10062003-23-7	<20	<200	<94	<5K
8	991-10062003-23-8	<20	<200	<94	<5K
9	991-10062003-23-9	<20	<200	<94	<5K
10	991-10062003-23-10	<20	<200	<94	<5K
11	991-10062003-23-11	<20	<200	<94	<5K
12	991-10062003-23-12	<20	<200	<94	<5K
13	991-10062003-23-13	<20	<200	<94	<5K
14	991-10062003-23-14	<20	<200	<94	<5K
15	991-10062003-23-15	<20	<200	<94	<5K
16	991-10062003-23-16	<20	<200	<94	<5K
17	991-10062003-23-17	<20	<200	<94	<5K
18	991-10062003-23-18	<20	<200	<94	<5K
19	991-10062003-23-19	<20	<200	<94	<5K
20	991-10062003-23-20	<20	<200	<94	<5K
21	991-10062003-23-21	<20	<200	<94	<5K
22	991-10062003-23-22	<20	<200	<94	<5K
23	991-10062003-23-23	<20	<200	<94	<5K
24	991-10062003-23-24	<20	<200	<94	<5K
25	991-10062003-23-25	<20	<200	<94	<5K
26	991-10062003-23-26	<20	<200	<94	<5K
27	991-10062003-23-27	<20	<200	<94	<5K
28	991-10062003-23-28	<20	<200	<94	<5K
29	991-10062003-23-29	<20	<200	<94	<5K
30	991-10062003-23-30	<20	<200	<94	<5K
31	991-10062003-23-31	<20	<200	<94	<5K
32	991-10062003-23-32	<20	<200	<94	<5K
33	991-10062003-23-33	<20	<200	<94	<5K
34	991-10062003-23-34	<20	<200	<94	<5K
35	991-10062003-23-35	<20	<200	<94	<5K
36	991-10062003-23-36	<20	<200	<94	<5K
37	991-10062003-23-37	<20	<200	<94	<5K
38	991-10062003-23-38	<20	<200	<94	<5K
39	991-10062003-23-39	<20	<200	<94	<5K
40	991-10062003-23-40	<20	<200	<94	<5K
41	991-10062003-23-41	<20	<200	<94	<5K
42	991-10062003-23-42	<20	<200	<94	<5K

Date Reviewed: 10/6/03 **RS Supervision:** T.Johnston / Tom Johnston / [redacted]

Print Name / Signature

17

October 08, 2003

Laboratory Report ID	03100706
Laboratory Name:	Johns Manville IH Lab
Subcontract Number:	KH020005
RIN:	04Z0050
Requestor:	Mark Simpson
P.O./Charge Code:	EFD991PD

QUICK RESULTS SUMMARY

Customer Number	Laboratory ID Number	Requested Analysis	Reporting Limit	CONCENTRATION			Q	Air Vol or Time	Air Concentration
				Back Section	Front Section	Total			
991-10062003-23-1	03100706-001	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-2	03100706-002	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-3	03100706-003	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-4	03100706-004	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-5	03100706-005	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-6	03100706-006	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-7	03100706-007	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-8	03100706-008	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-9	03100706-009	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-10	03100706-010	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-11	03100706-011	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-12	03100706-012	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-13	03100706-013	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-14	03100706-014	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-15	03100706-015	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-16	03100706-016	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-17	03100706-017	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-18	03100706-018	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-19	03100706-019	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-20	03100706-020	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-21	03100706-021	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-22	03100706-022	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-23	03100706-023	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-24	03100706-024	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-25	03100706-025	Beryllium	0.1 µg			< 0.1 µg	J		

18

October 08, 2003

Laboratory Report ID 03100706
Laboratory Name: Johns Manville IH Lab
Subcontract Number: KH020005
RIN: 04Z0050
Requestor: Mark Simpson
P.O./Charge Code: EFD991PD

QUICK RESULTS SUMMARY

Customer Number	Laboratory ID Number	Requested Analysis	Reporting Limit	CONCENTRATION Back Section	Front Section	Total	Q	Air Vol or Time	Air Concentration
991-10062003-23-26	03100706-026	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-27	03100706-027	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-28	03100706-028	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-29	03100706-029	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-30	03100706-030	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-31	03100706-031	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-32	03100706-032	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-33	03100706-033	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-34	03100706-034	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-35	03100706-035	Beryllium	0.1 µg			< 0.1 µg	J		
991-10062003-23-36	03100706-036	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-37	03100706-037	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-38	03100706-038	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-39	03100706-039	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-40	03100706-040	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-41	03100706-041	Beryllium	0.1 µg			< 0.1 µg	U		
991-10062003-23-42	03100706-042	Beryllium	0.1 µg			< 0.1 µg	U		

19

October 08, 2003

Laboratory Report ID: 03100706
Laboratory Name: Johns Manville IH Lab
Subcontract Number: KH020005
RIN: 04Z0050
Requestor: Mark Simpson
P.O./Charge Code: EFD991PD

QC RESULTS SUMMARY

QC Parameter	QC Item Type	Compound	Expected Recovery	Actual Recovery	Percent Recovery	QC Sample ID	Date Analyzed	Instrument Run
Preparation Blank	PB1	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank	MB1	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank Spike	MS1	Beryllium	5.0 µg	5.15 µg	103.0		10/8/2003	PB031008-E
Laboratory Control Sample	LC1	Beryllium	2.3 µg	2.41 µg	104.6	QC03081816	10/8/2003	PB031008-E
Laboratory Control Duplicate	LC1a	Beryllium	2.3 µg	2.41 µg	105.0	QC03081816	10/8/2003	PB031008-E
Preparation Blank	PB2	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank	MB2	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank Spike	MS2	Beryllium	5.0 µg	5.18 µg	103.5		10/8/2003	PB031008-E
Laboratory Control Sample	LC2	Beryllium	1.7 µg	1.72 µg	101.4	QC03081817	10/8/2003	PB031008-E
Laboratory Control Duplicate	LC2a	Beryllium	1.7 µg	1.70 µg	100.3	QC03081817	10/8/2003	PB031008-E
Preparation Blank	PB3	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank	MB3	Beryllium	< 0.1 µg	<0.1 µg	N/A		10/8/2003	PB031008-E
Matrix Blank Spike	MS3	Beryllium	5.0 µg	5.07 µg	101.4		10/8/2003	PB031008-E
Laboratory Control Sample	LC3	Beryllium	1.0 µg	1.01 µg	100.8	QC03081818	10/8/2003	PB031008-E
Laboratory Control Duplicate	LC3a	Beryllium	1.0 µg	0.995 µg	99.5	QC03081818	10/8/2003	PB031008-E

Enclosure 1
FEG-007-04

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 1A
PDS Results for Corridor B and Room 402

20

SURVEY UNIT 991-2-005
RADIOLOGICAL DATA SUMMARY - PDS

Survey Unit Description: B991 Interior Room 402 and 402A

21

Total Surface Activity Measurements

15	21
Number Required	Number Obtained

MIN	-2.5	dpm/100 cm^2
MAX	53.7	dpm/100 cm^2
MEAN	22.8	dpm/100 cm^2
STD DEV	15.9	dpm/100 cm^2
TRANSURANIC $DCGL_W$	100	dpm/100 cm^2

Removable Activity Measurements

15	21
Number Required	Number Obtained

MIN	-0.9	dpm/100 cm^2
MAX	3.6	dpm/100 cm^2
MEAN	1.0	dpm/100 cm^2
STD DEV	1.4	dpm/100 cm^2
TRANSURANIC $DCGL_W$	20	dpm/100 cm^2

SURVEY UNIT 985-2-005
TSA - DATA SUMMARY

Manufacturer:	NE Tech	NE Tech	NE Tech	NE Tech	NE Tech
Model:	DP-6	DP-6	DP-6	DP-6	DP-6
Instrument ID#:	1	2	6	7	8
Serial #:	1273	2352	3110	1589	2352
Cal Due Date:	7/23/04	5/11/04	7/12/04	7/19/04	5/11/04
Analysis Date:	1/26/04	1/26/04	1/27/04	1/27/04	1/27/04
Alpha Eff. (c/d):	0.208	0.222	0.211	0.215	0.222
Alpha Bkgd (cpm)	5.0	2.0	0.0	2.0	0.7
Sample Time (min)	1.5	1.5	1.5	1.5	1.5
LAB Time (min)	1.5	1.5	1.5	1.5	1.5
MDC (dpm/100cm^2)	48.0	48.0	48.0	48.0	48.0

Sample Location Number	Instrument ID#:	Sample Gross Counts (cpm)	Sample Gross Activity (dpm/100cm2)	LAB Gross Counts (cpm)	LAB Gross Activity (dpm/100cm2)	Sample Net Activity (dpm/100cm2)[1]
1	1	3.3	15.9	1.3	6.3	-2.5
2	1	8.7	41.8	2.0	9.6	23.5
3	2	12.0	54.1	2.0	9.0	35.7
4	1	7.3	35.1	2.7	13.0	16.7
5	1	6.7	32.2	2.3	11.1	13.8
6	1	10.0	48.1	2.7	13.0	29.7
7	2	6.7	30.2	4.0	18.0	11.8
8	1	3.3	15.9	0.7	3.4	-2.5
9	1	6.0	28.8	2.7	13.0	10.5
10	1	6.0	28.8	2.7	13.0	10.5
11	2	4.7	21.2	2.3	10.4	2.8
12	2	15.3	68.9	0.7	3.2	50.5
13	2	10.7	48.2	1.3	5.9	29.8
14	2	8.7	39.2	8.0	36.0	20.8
15	2	8.0	36.0	5.3	23.9	17.7
16	2	10.0	45.0	6.0	27.0	26.7
17	8	13.3	59.9	6.7	30.2	41.5
18	8	16.0	72.1	8.0	36.0	53.7
19	7	12.0	55.8	7.3	34.0	37.4
20	7	7.0	32.6	8.0	37.2	14.2
21	8	12.0	54.1	7.3	32.9	35.7

1 - Average LAB used to subtract from Gross Sample Activity

18.4	Sample LAB Average
MIN	-2.5
MAX	53.7
MEAN	22.8
SD	15.9
Transuranic DCGL$_W$	100

QC Measurements

2 QC	6	8.7	41.2	5.3	25.1	12.8
6 QC	6	11.3	53.6	6.7	31.8	25.1

1 - Average QC LAB used to subtract from Gross Sample Activity

28.4	QC LAB Average
MIN	12.8
MAX	25.1
MEAN	19.0
Transuranic DCGL$_W$	100

23

SURVEY UNIT 985-2-005
RSC - DATA SUMMARY

Manufacturer:	Eberline	Eberline	Eberline	Eberline
Model:	SAC-4	SAC-4	SAC-4	SAC-4
Instrument ID#:	3	4	9	10
Serial #:	830	770	924	966
Cal Due Date:	4/22/04	3/17/04	4/27/04	4/23/04
Analysis Date:	1/26/04	1/26/04	1/27/04	1/27/04
Alpha Eff. (c/d):	0.33	0.33	0.33	0.33
Alpha Bkgd (cpm)	0.0	0.3	0.3	0.3
Sample Time (min)	2	2	2	2
Bkgd Time (min)	10	10	10	10
MDC (dpm/100cm^2)	9.0	9.0	9.0	9.0

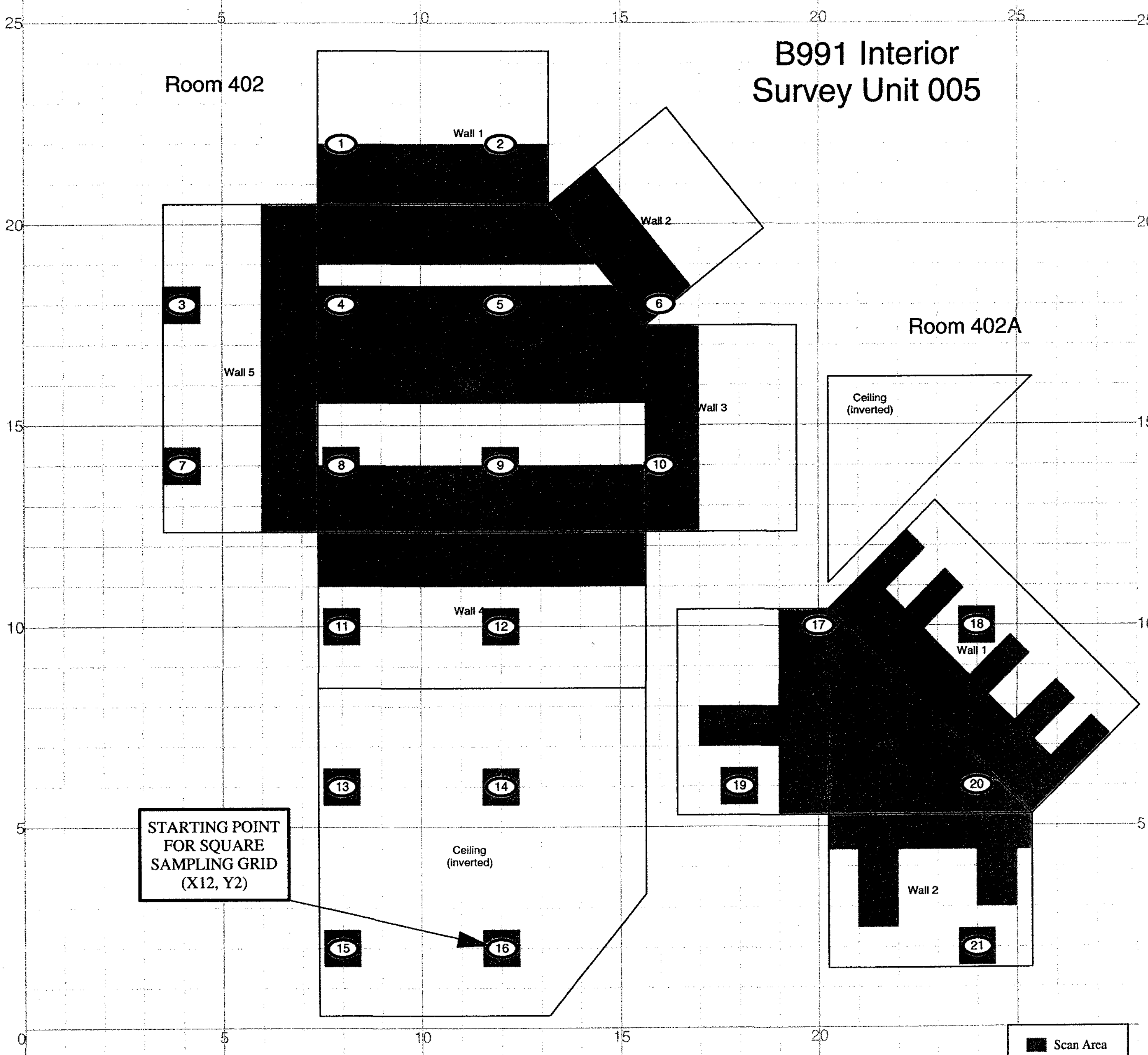
Sample Location Number	Instrument ID#	Gross Counts (cpm)	*Net Activity* (dpm/100 cm^2)
1	3	0	0.0
2	4	3	3.6
3	3	1	1.5
4	4	0	-0.9
5	3	0	0.0
6	4	0	-0.9
7	3	0	0.0
8	4	2	2.1
9	3	0	0.0
10	4	3	3.6
11	3	2	3.0
12	4	0	-0.9
13	3	0	0.0
14	4	1	0.6
15	3	1	1.5
16	4	1	0.6
17	9	1	0.6
18	10	2	2.1
19	9	2	2.1
20	10	1	0.6
21	9	2	2.1
		MIN	-0.9
		MAX	3.6
		MEAN	1.0
		SD	1.4
		Transuranic DCGL$_W$	**20**

24

PRE-DEMOLITION SURVEY FOR Area2, Group2

Survey Area: 2 **Survey Unit:** 991-2-005 **Classification:** 2
Building: 991
Survey Unit Description: B991 Interior, Room 402 and 402A
Total Area: 340 sq. m. **Total Floor Area:** 76 sq. m.
Grid Spacing for Survey Points: 4m. X 4m.

PAGE 1 OF 1



SURVEY MAP LEGEND
- Smear & TSA Location
- Smear, TSA & Sample Location
- Open/Inaccessible Area
- Area in Another Survey Unit

Neither the United States Government nor Kaiser Hill Co., nor CH2MHill, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

N

0 FEET 15
0 METERS 5

1 inch = 12 feet 1 grid sq. = 1 sq. m.

Scan Survey Information
Survey Instrument ID #(s) & RCT ID #(s):
2, 7, 8

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: GIS Dept. 303-966-7707
CH2MHILL Communications Group

Prepared for:
KAISER HILL COMPANY

MAP ID: 03-JS/A2G2/991-007A
Oct 8, 2003

25

SURVEY UNIT 991-2-008
RADIOLOGICAL DATA SUMMARY - PDS

Survey Unit Description: B991 West Tunnel Access Corridor

26

Total Surface Activity Measurements

Number Required	Number Obtained
17	18

MIN	-12.6	dpm/100 cm^2
MAX	23.3	dpm/100 cm^2
MEAN	4.6	dpm/100 cm^2
STD DEV	9.0	dpm/100 cm^2
TRANSURANIC $DCGL_W$	100	dpm/100 cm^2

Removable Activity Measurements

Number Required	Number Obtained
17	18

MIN	-1.8	dpm/100 cm^2
MAX	2.7	dpm/100 cm^2
MEAN	0.2	dpm/100 cm^2
STD DEV	1.3	dpm/100 cm^2
TRANSURANIC $DCGL_W$	20	dpm/100 cm^2

SURVEY UNIT 996-2-002
TSA - DATA SUMMARY

Manufacturer:	NE Tech	NE Tech
Model:	DP-6	DP-6
Instrument ID#:	5	9
Serial #:	1260	3114
Cal Due Date:	6/2/04	4/29/04
Analysis Date:	1/9/04	1/9/04
Alpha Eff. (c/d):	0.223	0.228
Alpha Bkgd (cpm)	3.0	1.0
Sample Time (min)	1.5	1.5
LAB Time (min)	1.5	1.5
MDC (dpm/100cm^2)	48.0	48.0

Sample Location Number	Instrument ID#:	Sample Gross Counts (cpm)	Sample Gross Activity (dpm/100cm2)	LAB Gross Counts (cpm)	LAB Gross Activity (dpm/100cm2)	Sample Net Activity (dpm/100cm2)[1]
1	5	0.0	0.0	3.0	13.5	-12.6
2	5	4.0	17.9	2.0	9.0	5.3
3	5	3.3	14.8	3.3	14.8	2.2
4	5	3.3	14.8	2.7	12.1	2.2
5	5	4.7	21.1	4.7	21.1	8.5
6	5	8.0	35.9	4.0	17.9	23.3
7	5	3.3	14.8	0.0	0.0	2.2
8	5	7.3	32.7	2.7	12.1	20.1
9	5	4.0	17.9	4.7	21.1	5.3
10	5	4.0	17.9	2.0	9.0	5.3
11	5	2.7	12.1	2.0	9.0	-0.5
12	5	1.3	5.8	4.0	17.9	-6.8
13	5	4.7	21.1	4.7	21.1	8.5
14	5	6.0	26.9	2.7	12.1	14.3
15	5	5.3	23.8	4.0	17.9	11.2
16	5	1.3	5.8	0.8	3.6	-6.8
17	5	2.7	12.1	0.0	0.0	-0.5
18	5	3.3	14.8	3.3	14.8	2.2

1 - Average LAB used to subtract from Gross Sample Activity

12.6	Sample LAB Average
MIN	-12.6
MAX	23.3
MEAN	4.6
SD	9.0
Transuranic $DCGL_W$	100

QC Measurements

8 QC	9	2.7	11.8	4.7	20.6	1.5
14 QC	9	3.3	14.5	0.0	0.0	4.2

1 - Average QC LAB used to subtract from Gross Sample Activity

10.3	QC LAB Average
MIN	1.5
MAX	4.2
MEAN	2.9
Transuranic $DCGL_W$	100

SURVEY UNIT 996-2-002
RSC - DATA SUMMARY

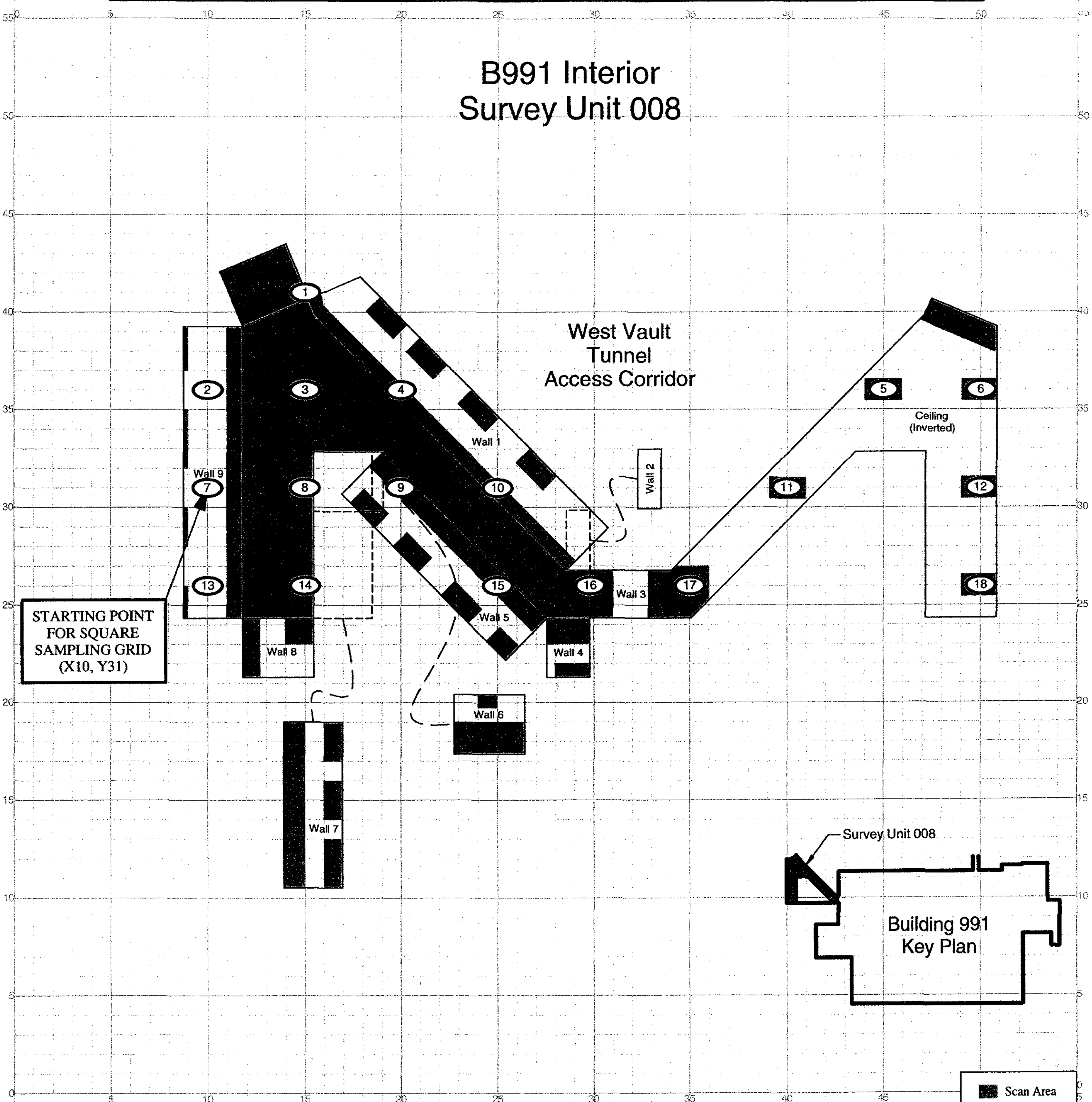
Manufacturer:	Eberline	Eberline	Eberline
Model:	SAC-4	SAC-4	SAC-4
Instrument ID#:	2	3	4
Serial #:	1164	984	845
Cal Due Date:	11/30/03	1/1/04	1/15/04
Analysis Date:	11/19/03	11/19/03	11/19/03
Alpha Eff. (c/d):	0.33	0.33	0.33
Alpha Bkgd (cpm)	0.6	0.2	0.1
Sample Time (min)	2	2	2
Bkgd Time (min)	10	10	10
MDC (dpm/100cm^2)	9.0	9.0	9.0

Sample Location Number	Instrument ID#	Gross Counts (cpm)	Net Activity (dpm/100 cm^2)
1	4	2	2.7
2	2	1	-0.3
3	3	1	0.9
4	4	0	-0.3
5	4	0	-0.3
6	2	2	1.2
7	3	1	0.9
8	4	2	2.7
9	4	0	-0.3
10	2	2	1.2
11	3	0	-0.6
12	4	0	-0.3
13	4	0	-0.3
14	2	0	-1.8
15	3	0	-0.6
16	4	1	1.2
17	4	0	-0.3
18	2	0	-1.8
		MIN	-1.8
		MAX	2.7
		MEAN	0.2
		SD	1.3
		Transuranic DCGL$_W$	20

29

PRE-DEMOLITION SURVEY FOR AREA 2, GROUP 2

Survey Area: 2 **Survey Unit:** 991-2-008 **Classification:** 1
Building: 991
Survey Unit Description: B991 Interior, West Tunnel Access Corridor
Total Area: 440 sq. m. **Total Floor Area:** 112 sq. m.
Grid Spacing for Survey Points: 5m. X 5m.



SURVEY MAP LEGEND

- Smear & TSA Location
- Smear, TSA & Sample Location
- Open/Inaccessible Area
- Area in Another Survey Unit

Neither the United States Government nor Kaiser Hill Co., nor CH2MHill, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

N

0 FEET 30
0 METERS 10

1 inch = 24 feet 1 grid sq. = 1 sq. m.

Scan Survey Information
Survey Instrument ID #(s) & RCT ID #(s):
6, 7, 8, 9, 10

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: GIS Dept. 303-966-7707
Prepared for:

CH2MHILL Communications Group

KAISER-HILL COMPANY

MAP ID: 03-JS/991-008-SC

Jan. 13, 2004

30

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 2
UBC 900-1 Sampling Results

21

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 3
Structural Analysis for Corridor A and Vault 998

CALCULATION/OTHER DOCUMENTS COVER SHEET

CALCULATION NUMBER CALC – 998 - BS - 000001 **Rev.** 0

Section 1: IDENTIFICATION

1. WCF or /Authorization Project Number	2. Project Title	3. Page
EFD58300	B998 VAULT & TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION	1 of 28

3. System Identification (See SX-164, Plant System and Component Identification and Labeling)	4. Other (Type of document, e.g., Studies, Conceptual Design Report, Design Criteria, etc.)
NA	Capacity Analysis
6. Natural Phenomena Hazard Performance Category (PC) Number ☒ PC-0 / NA ☐ PC-1 ☐ PC-2 ☐ PC-3	7. Building Number B998

8. Engineering Discipline(s) Involved with Calculation:

STRUCTURAL

Section 2: SIGNATURES FOR A CALCULATION

	Discipline	Print Name	Sign	Date
9. Designer(s)	Structural	Keith MacLeod	Keith MacLeod	1/20/04
10. Checker(s)	Structural	Tom Frank	Tom H Frank	01/20/04
11. Independent Verifier (for PC-0/NA and PC-1)	Structural	Tom Frank	Tom H Frank	01/20/04
12. Peer Reviewer (for PC-2 and PC-3)	NA			
13. Responsible Engineering Manager	PCE	Tim Humiston	T Humiston	1/20/04
14. Classification Review	DC	W. J. McAndrew	U/NU	1/20/04

Section 3: SIGNATURES FOR OTHER DOCUMENTS

	Discipline	Print Name	Sign	Date
15. Preparer				

Section 4: REVISION SUMMARY

16. Description	17. Affected Pages

CALCULATION CONTROL NUMBER: CALC – 998 – BS – 000001 (REV. 0)

1. **IWCP/Authorization Project Number:** EFD58300

2. **Calculation Title:** B998 VAULT & TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

3. **Calculation Description:**

The site is considering leaving the concrete of B998 Vault & Tunnel in place and not removing them for the final site closure. This calculation addresses two factors that will be involved with this consideration, which are as follows:

1. What is the projected number of years that the vault & tunnel will remain standing before it begins to collapse.
2. What will be the depression in the ground surface when the tunnel does collapse.

Therefore, an analysis of the tunnel structure's present strength and condition is needed to determine what the future long term condition of the tunnel may be. From the analysis a projection can be made as to how many years before the tunnel begins to collapse. The analysis is based on the vault & tunnel loaded only with the soil overburden that will be the final grade of the site. The vault & tunnel will not be subject to any vehicle traffic. The analysis is also based on the groundwater rising after the footing drains fail, and the tunnel will be exposed to the corrosive effects of water.

4. **Natural Phenomena Hazard Performance Category:** NA

It can be reasonably assumed that if an earthquake does occur it will not effect the tunnel, because the tunnel is buried and supported all around by soil.

5. **Calculation Objectives (List):**

The objective is to calculate the strength of the vault & tunnel without steel rebar reinforcement and just with the strength of the concrete. This will give an indication of whether the tunnel can support its own weight and overburden over a long period of time, once the reinforcement has completely corroded. After closure the footing drains are likely to become inoperable over time and the natural groundwater flows are expected to rise above the vault and tunnel at least part of each year.. This will expose the vault and tunnel to water, and over a long enough period of time the reinforcement will corrode.

Lastly, modeling of the ground surface after the tunnel roof collapses will be evaluated.

6. **List Methods used for Calculation:** Standard engineering design practice and by engineering methods of the (ACI) American Concrete Institute.

7. **List Assumptions used:** It is assumed that after a period of time the footing drains will fail and the groundwater will rise, which will expose most of the tunnel to the corrosive effects of water. This is based on the report "Hydraulic Effects on Decommissioning Building 997" by Bob Prucha, Integrated Hydro Systems, November 25, 2002.

CALCULATION CONTROL NUMBER: CALC – 998 – BS – 000001 (REV. 0)

8. Identify References:

1. ACI 318-89 American Concrete Institute 1989 Edition.
2. Drawings (attached):
   Building No. 98 Plan & Det.- (RF-98-A-1-C) (RFETS No. – 00A01-001U - Arch)
   Building No. 98 Concrete Det.- (RF-98-S1-C) (RFETS No. – 00S01-001Y – Bldg.)
   Building No. 98 Conc. Tunnel- (RF-98-S2-C) (RFETS No. – 00S02-001R - Bldg.)
   Building No. 98 Repair Wall Crack - (RFETS No. – 38072-001 – A – Bldg.)
   Building No. 91 Misc. Dets. – (RF-91-A-26-C)(RFETS No. – 00A26-001B - Arch)
   Building No. 91 Misc. Dets. – (RF-91-F-2-C)(RFETS No. – 00F02-001G – Bldg.)
3. Soil Overburden Survey Datum Drawing by PCG (7-20-92).
4. "Results of Building 991 and 998 Vault Modeling Simulations" by Bob Prucha, December 29, 2003. (partial copy attached)

9. Identify Applicable Design Related AB Documents: N/A

10. Body of Calculation: Refer to the following calculation pages.

11. Calculation Conclusion:

11.1 B998 Vault & Tunnel Structural Prediction of Long Term Condition of Tunnel

11.1.1 Present Strength & Condition of B998 Vault and Tunnel Structural

The B998 vault and tunnel are in good condition with no evidence of corrosion, movements or settlements. There are no cracks except at one location (approx. 52 ft. North of B991) that was repaired (5-6-87) (see dwg. 38072-001). The D & D plan for B998 vault and tunnel is to demolish the first 60 ft. of the tunnel from B991 and foam the end. The rest of the tunnel and vault will be left in place and covered with soil.

11.1.2 Future Projected Condition of B998 Vault and Tunnel Structural

The future integrity of the structural strength of the vault and tunnel will be dependent on the amount of water that the vault and tunnel is exposed to. The groundwater study "Results of Building 991 and 998 Vault Modeling Simulations" by Bob Prucha, (December 29, 2003), reports that the future groundwater expectations for a wet year can rise to approximately 9 feet of the surface. Refer to drawing (RF-98-A-1-C) for elevations. The top of the vault is 14 ft. below the surface and the tunnel is 18 ft. (max.) to 3 (min.) ft. below the surface. Therefore, after site closure the vault and tunnel are expected to be exposed, inside and out to ground water, for at least part of each year.

11.1.3 Long Term Durability of B998 Vault and Tunnel

The deterioration of the vault and tunnel will be from ground water seepage into the concrete resulting in corrosion of the reinforcement. At some period of time, the reinforcement may become ineffective. The final strength of the vault and tunnel will depend on the uncracked ultimate tensile (rupture) strength of the concrete. When the concrete eventually deteriorates and cracks, the roofs will lose all strength and collapse. The collapse of the roof will cause the soil overburden to fill the vault and tunnel and cause a depression on the ground surface.

Therefore, the long term durability of the vault and tunnel is dependent on the period of time for the groundwater to corrode the reinforcement and later degrade the concrete leading to the roof collapse. Because of the good condition of the tunnels and vaults and the probability that the tunnels and vaults will only be exposed to ground water part of each year, it may take approximately 500 years or longer for the reinforcement to corrode. Once the reinforcement has completely corroded it could take another 500 years or longer for the concrete to deteriorate enough so that the roofs will collapse. Also, the tunnel is narrow (7.5 ft. inside width), so once the roof of the tunnel begins to fail, the soil above the tunnel will arch over the roof to the side walls and the soil on each side of the tunnel.

11.2 The following are the results of the tunnels and vaults concrete analysis to support the soil overburden (Reference sketch in calculations of following pages):

11.2.1 B998 Vault

The calculations show that the vault concrete roof **can** support the final soil overburden without the reinforcing steel.

- Therefore, a conservative engineering estimate would be that the tunnels could continue to exist without collapsing for at least **1,000 to 2,000 years.**
- The final depression at the surface will be a trapezoidal shaped trench with assumed 45 degree sloped sides and the following approximate dimensions:

Vault Depression at Ground Surface will be Trapezoidal Shaped (Refer to Sketch):

Dimensions: Depth = 1.1 ft. x 50.8 ft. Wide x 55.8 ft. Length at Surface

x 48.6 ft. Wide x 53.6 ft. Length at Bottom

11.2.2 B998 Tunnel

The calculations show that the vault concrete roof **can** support the final soil overburden without the reinforcing steel.

- Therefore, a conservative engineering estimate would be that the tunnels could continue to exist without collapsing for at least **1,000 to 2,000 years.**
- The final depression at the surface will be a trapezoidal shaped trench with assumed 45 degree sloped sides and the following approximate dimensions:

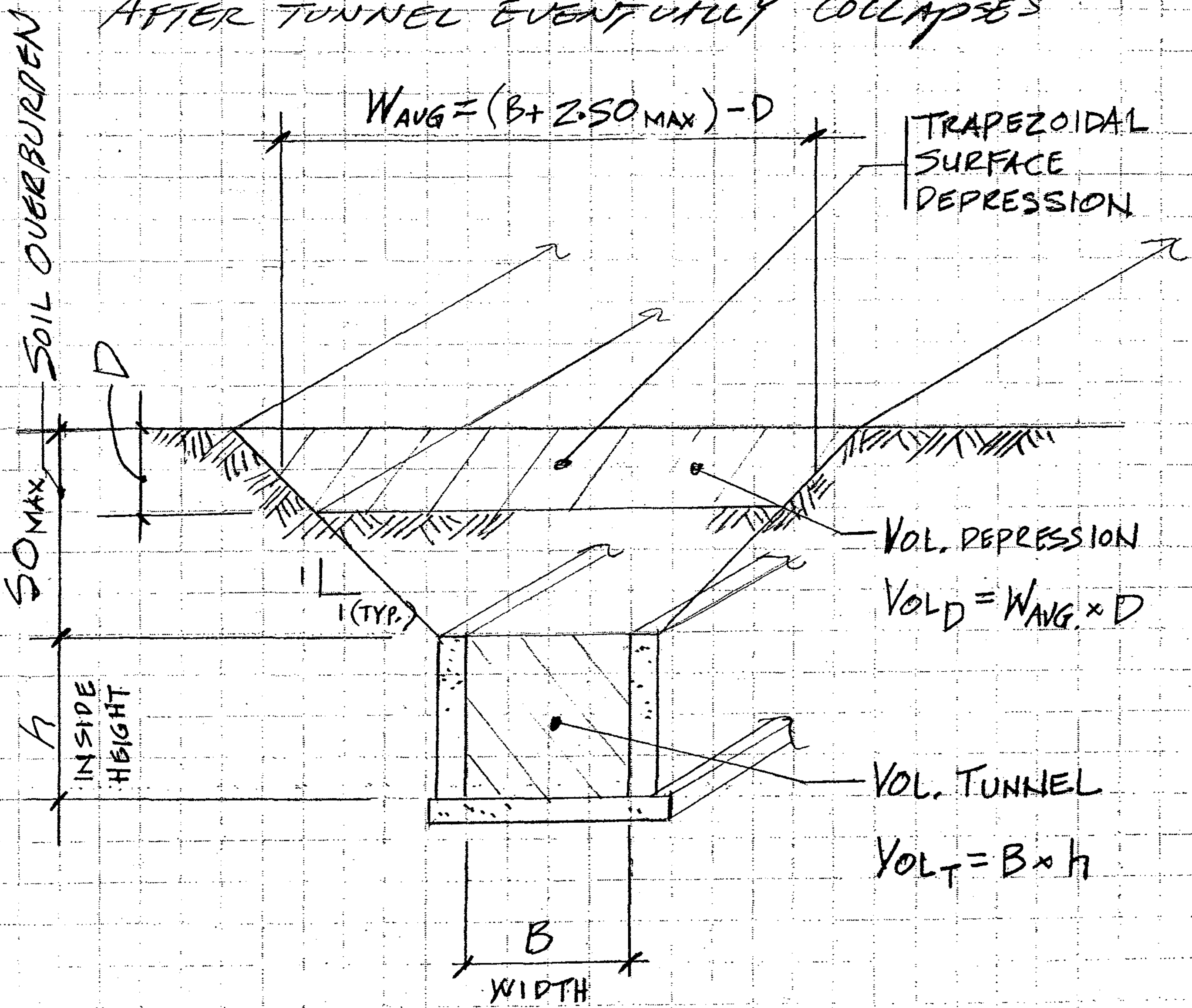
Tunnel Depression at Ground Surface will be Trapezoidal Shaped (Refer to Sketch):

Dimensions: Depth = 1.7 ft. x 42.8 ft. Wide at Surface

x 39.4 ft. Wide at Bottom

B998 VAULT & TUNNEL STRUCT. ANALYSIS

TUNNEL SURFACE DEPRESSION
AFTER TUNNEL EVENTUALLY COLLAPSES



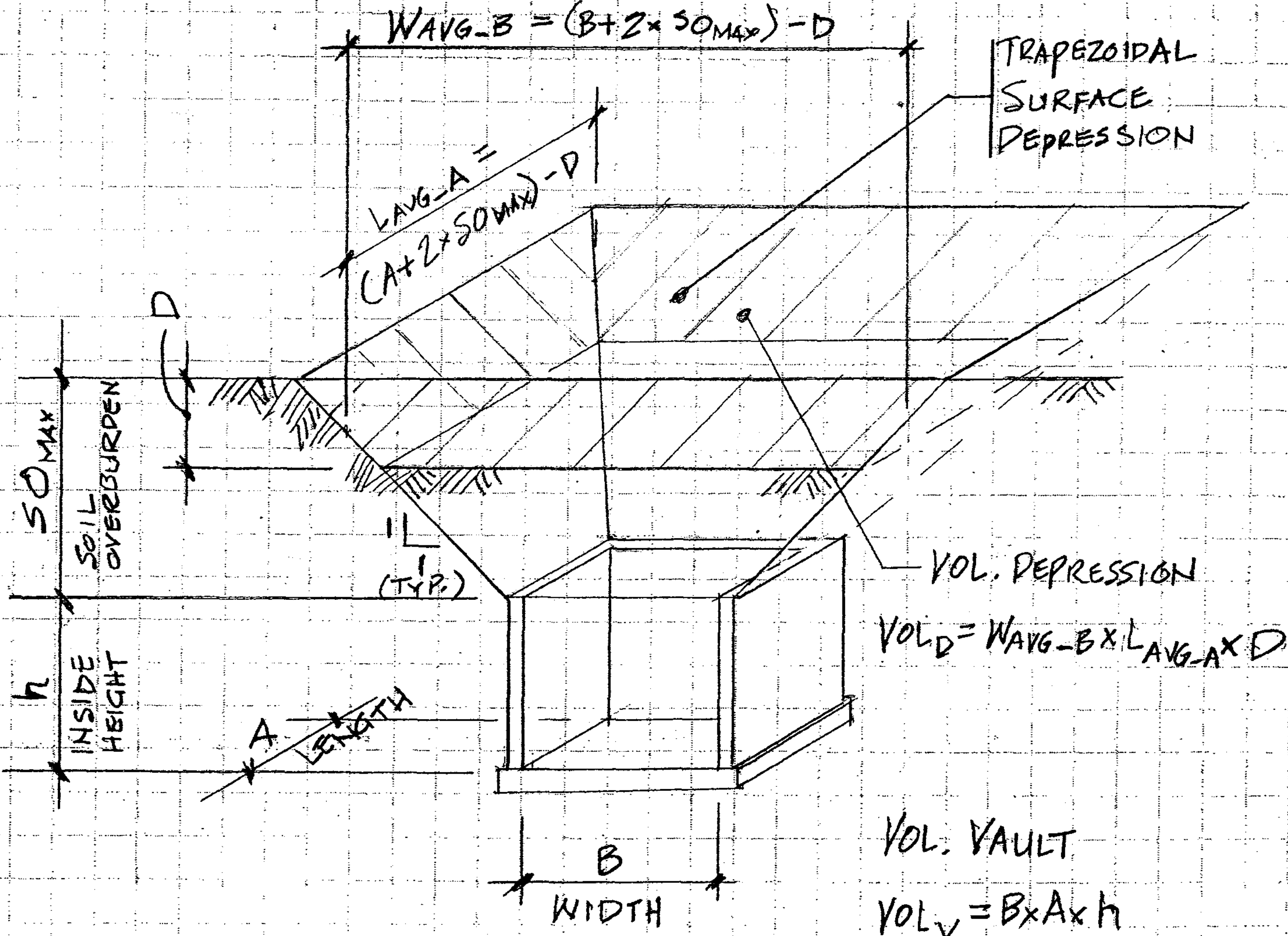
SECTION THROUGH TUNNEL

SURFACE DEPRESSION (TRAPEZOIDAL SHAPED)
AFTER ROOF FAILURE

B998 VAULT & TUNNEL STRUCT. ANALYSIS

VAULT SURFACE DEPRESSION

AFTER VAULT EVENTUALLY COLLAPSES



SECTION THROUGH VAULT

SURFACE DEPRESSION (TRAPEZOIDAL SHAPED) AFTER ROOF FAILURE

B998 VAULT STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Refer to Calculation Template Reference Drawings for all calculation values.

$in := ft \cdot 12^{-1}$ $plf := lb \cdot ft^{-1}$ $psf := lb \cdot ft^{-2}$ $pcf := lb \cdot ft^{-3}$ $psi := lb \cdot in^{-2}$

Soil Weight: Dry Soil Weight = 100 pcf Wet Soil Weight = 120 pcf Use Soil Weight ===> $\gamma := 110 \cdot pcf$

Concrete Compressive Strength:

(Refer Drawing Building No. 91 Misc. Dets. (RF-91-F-2-C) (RFETS No. 00F02-001G Bldg.)

$f'c := 3000$ lb/sq.in.

Tension (rupture) Capacity of Concrete:

(Reference: ACI-318-89 sec. 9.5.23 (9-9) page 97)

$fr := 7.7 \cdot \sqrt{f'c} \cdot psi$ $fr = 421.75\,psi$

Vault Soil Overburden:

Top of Vault Floor Elevation: $T_{\_flr\_el} := 5935.33 \cdot ft$ Vault Height: $T_H := 15.875 \cdot ft$

Max. Top of Final Grade: $T_{max\_Gr} := 5965.0 \cdot ft$

Max. Vault Soil Overburden: $SO_{max} := T_{max\_Gr} - (T_{\_flr\_el} + T_H)$

$\boxed{SO_{max} = 13.8\,ft}$ <<<===

Vault Roof Strength Capacity Without Reinforcement:

Vault Roof Thickness: $R_{th} := 2.5 \cdot ft$

Vault Roof Span: $R_{sp} := 15.0 \cdot ft$

Load on Vault Roof:

Soil Weight: $S_{wt} := \gamma \cdot SO_{max}$ $S_{wt} = 1517.45\,psf$

Concrete Weight: $C_{wt} := 150 \cdot pcf \cdot R_{th}$ $C_{wt} = 375\,psf$

Load on Vault Roof Per ft. width: $R_{Ld} := (S_{wt} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld} = 1892.45\,plf}$ <<<===

B998 VAULT STRUCTURAL ANALYSIS
FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod

Project Number: EFD58300

Vault Roof Soil Overburden Moment Per ft. Width :

(Assume the end supports are between "Fixed" and "Simple") (Ref. AISC pages 2-296 & 2-301)

$$M_{max} := \frac{R_{Ld} \cdot (R_{sp})^2}{10} \qquad \boxed{M_{max} = 42580.13\,\mathrm{lb\,ft}} \qquad <<<====$$

Section Modulus of Roof Per ft. Width: $S_R := \frac{12 \cdot in \cdot (R_{th})^2}{6}$ $\quad S_R = 1800\,\mathrm{in}^3$

Vault Roof Cracking Moment: (Concrete Tension Rupture Capacity times Section Modulus)

$$M_{CR} := fr \cdot S_R \qquad M_{CR} = 63261.96\,\mathrm{lb\,ft} > M_{max} = 42580.13\,\mathrm{lb\,ft} \qquad <<<====$$

O.K.

Vault Roof Cracking Moment is Larger than Soil Overburden Roof Moment

Therefore, the Vault Concrete Roof Can Support the Soil Overburden

Without Reinforcement

B998 VAULT DEPRESSION AT THE GROUND SURFACE WHEN VAULT EVENTUALLY COLLAPSES

By: K. MacLeod

Project Number: EFD58300

Refer to Calculation Template Reference Drawings for all calculation values.
Refer to Vault Depression Sketch

Depression After Vault Collapses:

(Assume soil settles at 45 degrees on the sides)

Vault Inside Dimensions: Width: $B := 15.0 \cdot ft$ Length: $A := 20.0 \cdot ft$

Inside Height: $h := 10.0 \cdot ft$

Soil Overburden: $SO_{max} := 17.92 \cdot ft$

Volume Inside Vault: $Vol_V := B \cdot A \cdot h$ $Vol_V = 3000\,ft^3$

Depth of Depression: $D := 2.0 \cdot ft$

Average Width of Depression: $W_{avg\_B} := (B + 2 \cdot SO_{max}) - D$

Average Length of Depression: $L_{avg\_A} := (A + 2 \cdot SO_{max}) - D$

(>>>> Depression Depth must be adjusted for Depression Volume = Vault Inside Volume <<<<)

==>> Try: $D := 1.1 \cdot ft$ $W_{avg\_B} := (B + 2 \cdot SO_{max}) - D$ $W_{avg\_B} = 49.74\,ft$

$L_{avg\_A} := (A + 2 \cdot SO_{max}) - D$ $L_{avg\_A} = 54.74\,ft$

Volume of Depression: $Vol_D := W_{avg\_B} \cdot L_{avg\_A} \cdot D$

$Vol_D = 2995.04\,ft^3$ $=$ $Vol_V = 3000\,ft^3$ <<=== O.K.

Dimensions At Surface of Depression: $W_{sur\_B} := (B + 2 \cdot SO_{max})$ $W_{sur\_B} = 50.84\,ft$

$L_{sur\_A} := (A + 2 \cdot SO_{max})$ $L_{sur\_A} = 55.84\,ft$

Dimensions At Bottom of Depression: $W_{Bot\_B} := (B + 2 \cdot SO_{max}) - 2 \cdot D$ $W_{Bot\_B} = 48.64\,ft$

$L_{Bot\_A} := (A + 2 \cdot SO_{max}) - 2D$ $L_{Bot\_A} = 53.64\,ft$

Vault Depression at Ground Surface will be Trapezoidal Shaped:

1.1 ft. Deep with: Dimensions at Surface: 50.8' Wide x 55.8' Length
Dimensions at Bottom: 48.6' Wide x 53.6' Length

Refer to Sketch

B998 TUNNEL STRUCTURAL ANALYSIS
FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Refer to Calculation Template Reference Drawings for all calculation values.

$in := ft \cdot 12^{-1}$ $plf := lb \cdot ft^{-1}$ $psf := lb \cdot ft^{-2}$ $pcf := lb \cdot ft^{-3}$ $psi := lb \cdot in^{-2}$

Soil Weight: Dry Soil Weight = 100 pcf
Wet Soil Weight = 120 pcf
Use Soil Weight ===> $\gamma := 110 \cdot pcf$

Concrete Compressive Strength:

(Refer Drawing Building No. 91 Misc. Dets. (RF-91-F-2-C) (RFETS No. 00F02-001G Bldg.)

$f'c := 3000$ lb/sq.in.

Tension (rupture) Capacity of Concrete:

(Reference: ACI-318-89 sec. 9.5.23 (9-9) page 97)

$fr := 7.7 \cdot \sqrt{f'c} \cdot psi$ $fr = 421.75\,psi$

Tunnel Soil Overburden:

Top of Tunnel Floor Elevation: $T_{\_flr\_el} := 5935.33 \cdot ft$ Tunnel Height: $T_H := 11.75 \cdot ft$

Max. Top of Final Grade: $T_{max\_Gr} := 5965.0 \cdot ft$

Max. Tunnel Soil Overburden: $SO_{max} := T_{max\_Gr} - (T_{\_flr\_el} + T_H)$

$\boxed{SO_{max} = 17.92\,ft}$ <<<===

Tunnel Roof Strength Capacity Without Reinforcement:

Tunnel Roof Thickness: $R_{th} := 1.25 \cdot ft$

Tunnel Roof Span: $R_{sp} := 7.5 \cdot ft$

Load on Tunnel Roof:

Soil Weight: $S_{wt} := \gamma \cdot SO_{max}$ $S_{wt} = 1971.2\,psf$

Concrete Weight: $C_{wt} := 150 \cdot pcf \cdot R_{th}$ $C_{wt} = 187.5\,psf$

Load on Tunnel Roof Per ft. width: $R_{Ld} := (S_{wt} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld} = 2158.7\,plf}$ <<<===

Tunnel Roof Soil Overburden Moment Per ft. Width :

(Assume the end supports are between "Fixed" and "Simple") (Ref. AISC pages 2-296 & 2-301)

$$M_{max} := \frac{R_{Ld} \cdot (R_{sp})^2}{10} \qquad \boxed{M_{max} = 12142.69 \, \text{lb ft}} \qquad \text{<<<====}$$

Section Modulus of Roof Per ft. Width:

$$S_R := \frac{12 \cdot \text{in} \cdot (R_{th})^2}{6} \qquad S_R = 450 \, \text{in}^3$$

Tunnel Roof Cracking Moment: (Concrete Tension Rupture Capacity times Section Modulus)

$$M_{CR} := fr \cdot S_R \qquad M_{CR} = 15815.49 \, \text{lb ft} > M_{max} = 12142.69 \, \text{lb ft} \qquad \text{<<<====} \qquad \underline{\text{O.K.}}$$

Tunnel Roof Cracking Moment is Larger than Soil Overburden Roof Moment

Therefore, the Tunnel Concrete Roof Can Support the Soil Overburden

Without Reinforcement

B998 TUNNEL DEPRESSION AT THE GROUND SURFACE WHEN TUNNEL EVENTUALLY COLLAPSE

By: K. MacLeod

Project Number: EFD58300

Refer to Calculation Template References Drawings for all calculation values.
Refer to Tunnel Depression Sketch

Depression After Tunnel Collapses:

(Assume soil settles at 45 degrees on the sides)

Tunnel Inside Dimensions: Width: $B := 7.0 \cdot ft$ Inside Height: $h := 10.0 \cdot ft$

Soil Overburden: $SO_{max} = 17.92\,ft$ $SO_{min} := 10.0 \cdot ft$

Volume Inside Tunnel: $Vol_T := B \cdot h$ $Vol_T = 70\,ft^2$

Depth of Depression: $D := 2.0 \cdot ft$

Average Width of Depression: $W_{avg} := (B + 2 \cdot SO_{max}) - D$

(>>>> Depression Depth must be adjusted for Depression Volume = Tunnel Inside Volume <<<<)

==>> Try: $D := 1.7 \cdot ft$ $W_{avg} := (B + 2 \cdot SO_{max}) - D$ $W_{avg} = 41.14\,ft$

Volume of Depression: $Vol_D := W_{avg} \cdot D$ $Vol_D = 69.94\,ft^2 = Vol_T = 70\,ft^2$ <<== O.K.

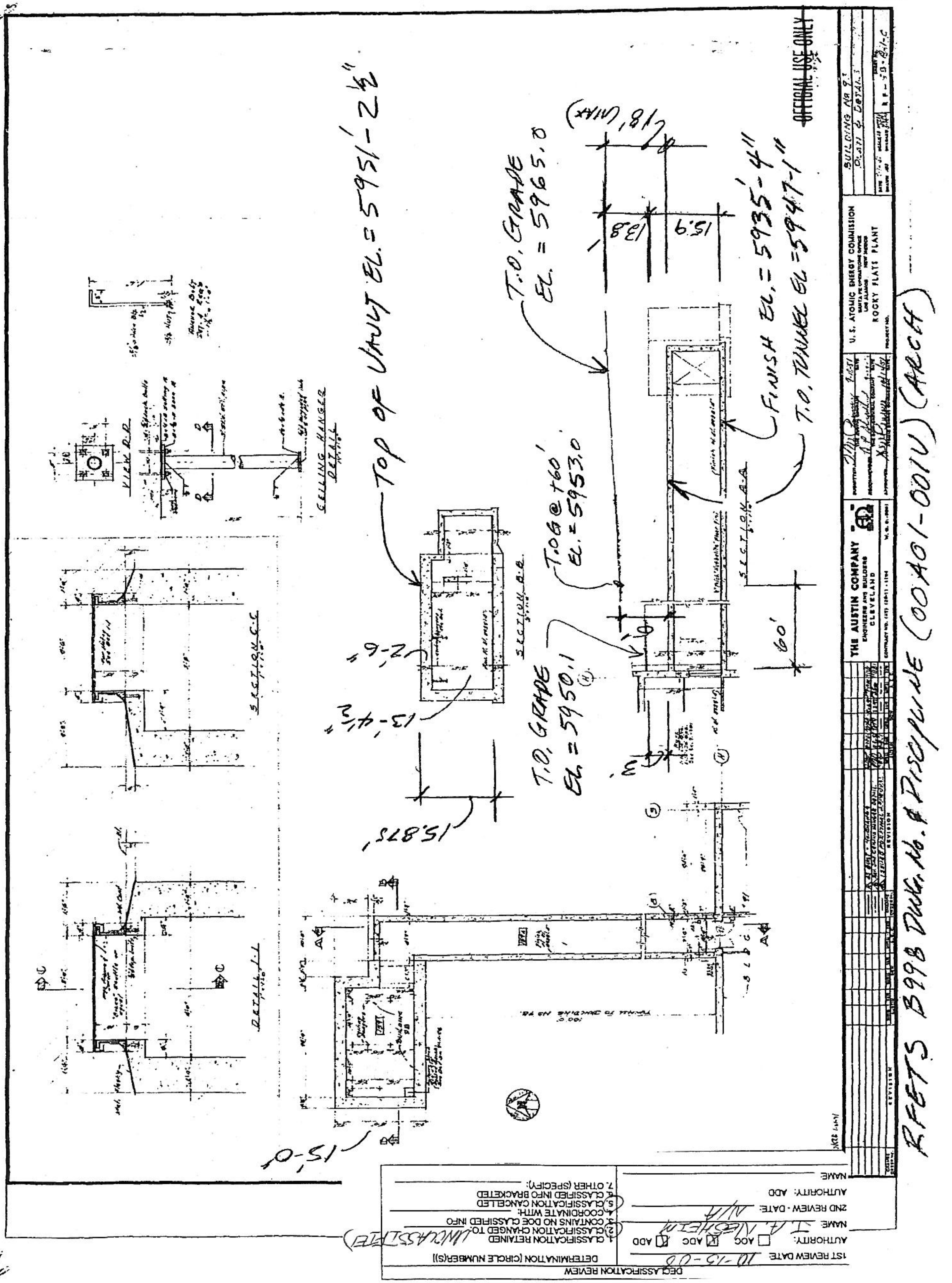
Dimensions At Surface of Depression: $W_{sur\_B} := (B + 2 \cdot SO_{max})$ $W_{sur\_B} = 42.84\,ft$

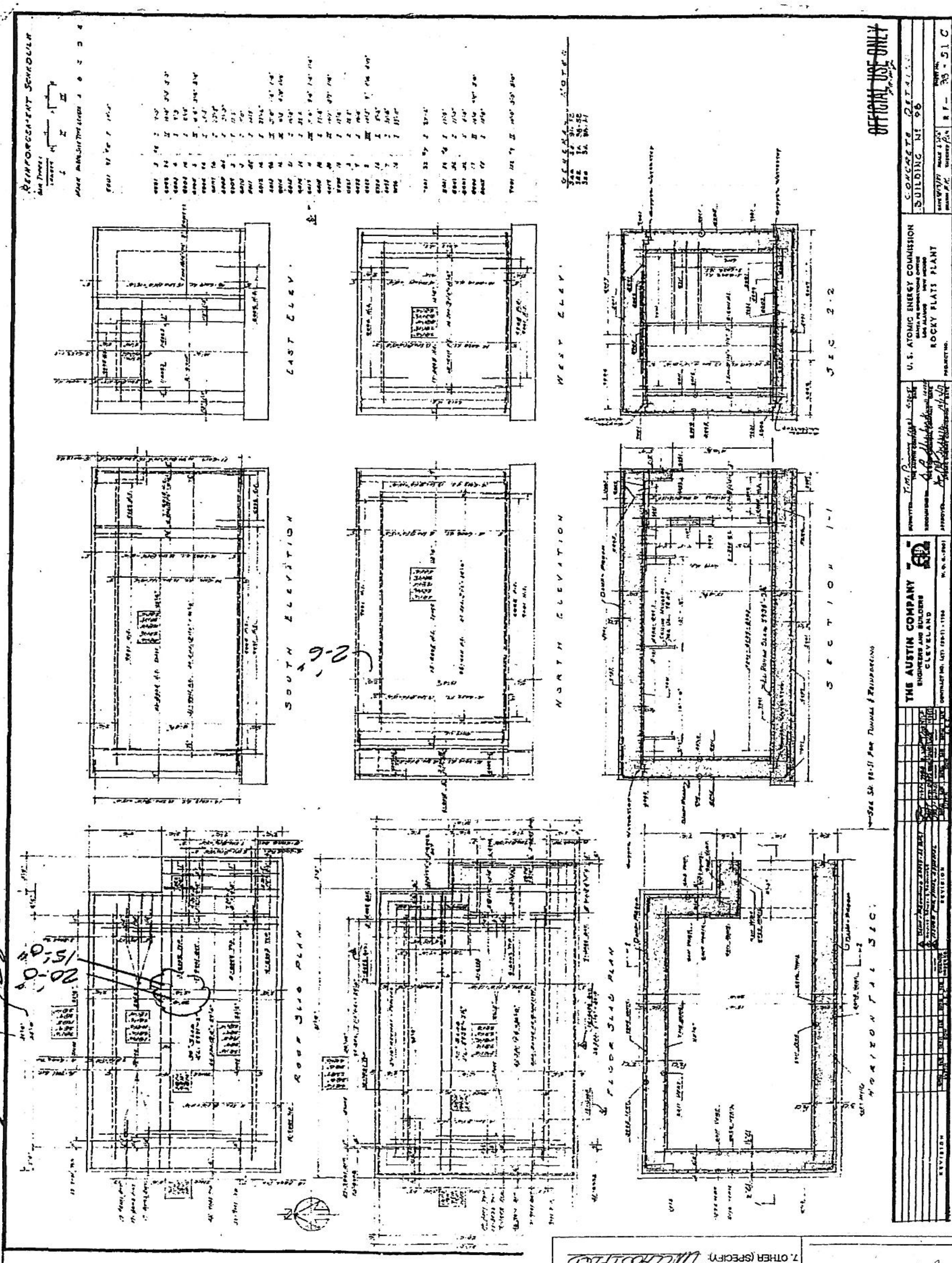
Dimensions At Bottom of Depression: $W_{Bot\_B} := (B + 2 \cdot SO_{max}) - 2 \cdot D$ $W_{Bot\_B} = 39.44\,ft$

Tunnel Depression AT Ground Surface Will Be Trapezoidal Shaped:

1.7 ft. Deep x 42.8 Wide at Surface To 39.4 ft. Wide At the Bottom

Refer to Sketch


OFFICIAL USE ONLY
TOP OF VAULT EL. = 5951'-2½"
T.O. GRADE EL. = 5965.0
T.O. GRADE EL. = 5950.1
T.O.G @ +60' EL. = 5953.0
FINISH EL. = 5935'-4"
T.O. TUNNEL EL = 5947'-1"
18' (MAX)
13.8
15.9
60'
15.875'
13'-4½"
12'-9"
15'-0"
SECTION C-C
DETAIL 1-1
SECTION B-B
SECTION A-A
CEILING HANGER DETAIL
VIEW D-D
THE AUSTIN COMPANY ENGINEERS AND BUILDERS CLEVELAND
U.S. ATOMIC ENERGY COMMISSION ROCKY FLATS PLANT
BUILDING NO. 9
RFETS B998 DWG. NO. # DISCIPLINE (00A01-001U) (ARCH)
DECLASSIFICATION REVIEW
1ST REVIEW DATE: 10-15-08
AUTHORITY: ADC ADD
NAME: T. A. NESHEIM
2ND REVIEW - DATE: N/A
AUTHORITY: ADD
NAME:
DETERMINATION (CIRCLE NUMBER(S))
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO: UNCLASSIFIED
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY):



RFCTS B998 DWG. No. & DISCIPLINE (00501-0014) (BUILDING)

DECLASSIFICATION REVIEW

1ST REVIEW DATE: 10-15-08

AUTHORITY: ☐ AOC ☒ ADC ☒ ADD

NAME: J.A. NESHEIM

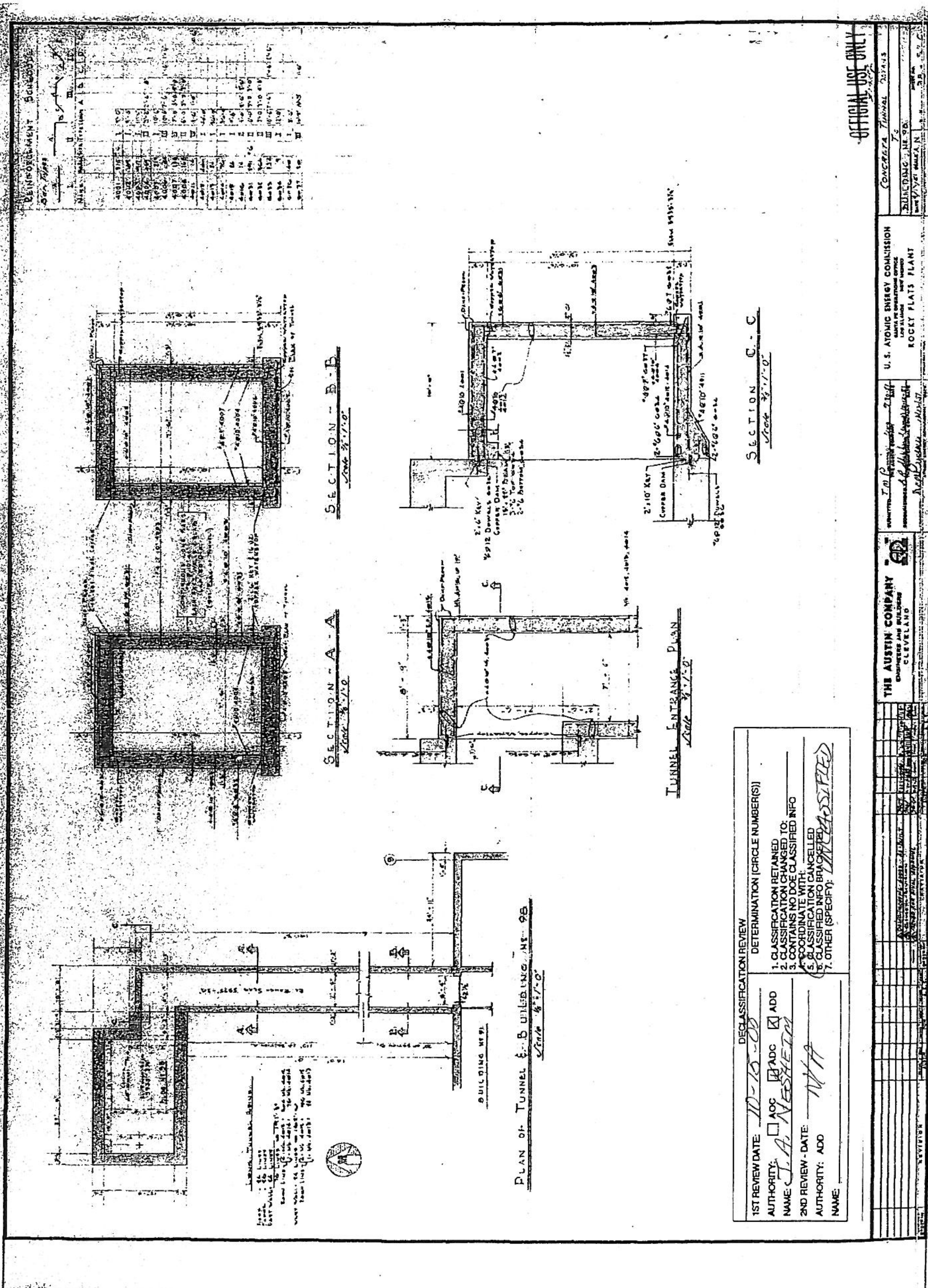
2ND REVIEW - DATE: N/A

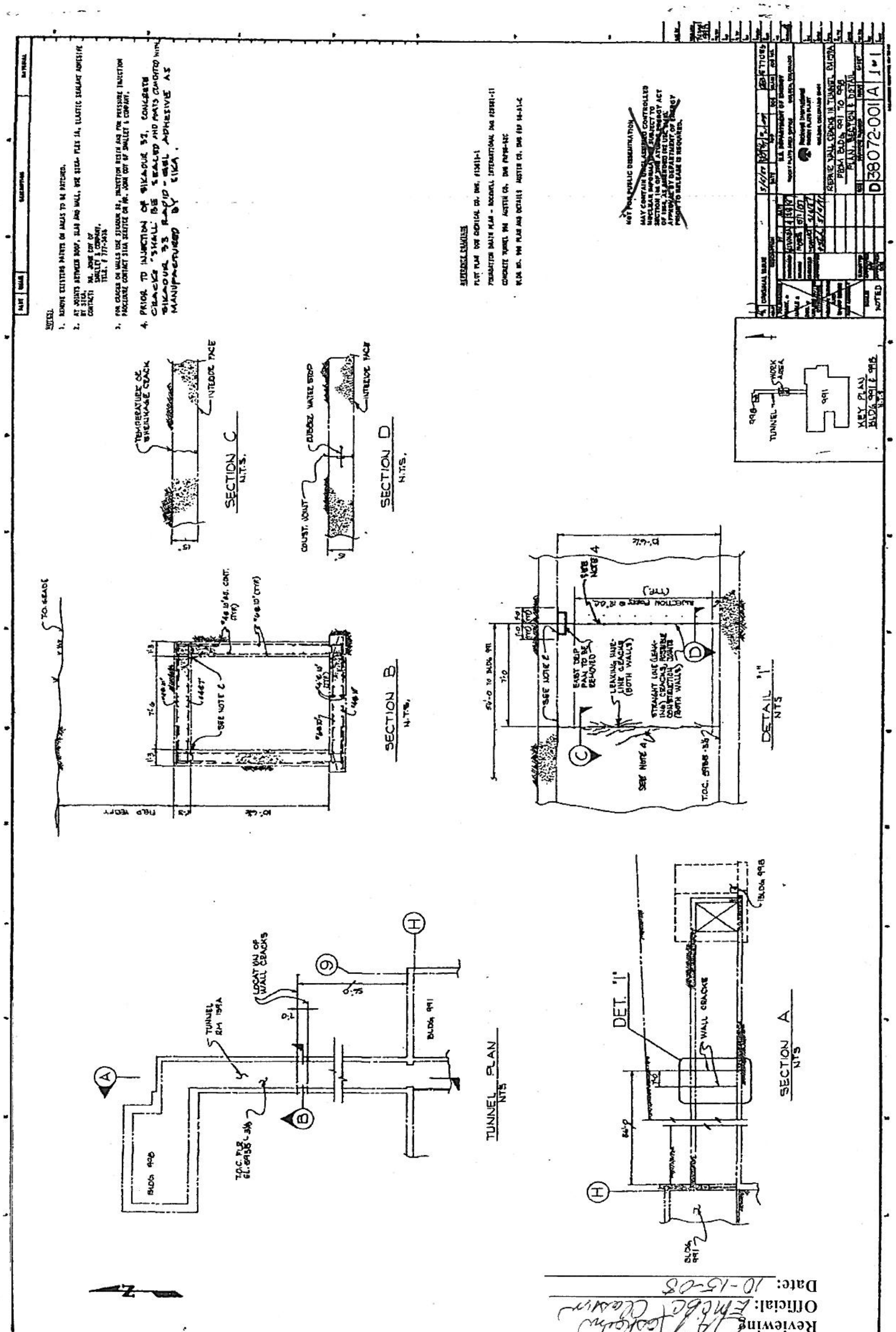
AUTHORITY: ADD

NAME:

DETERMINATION [CIRCLE NUMBER(S)]

1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): UNCLASSIFIED

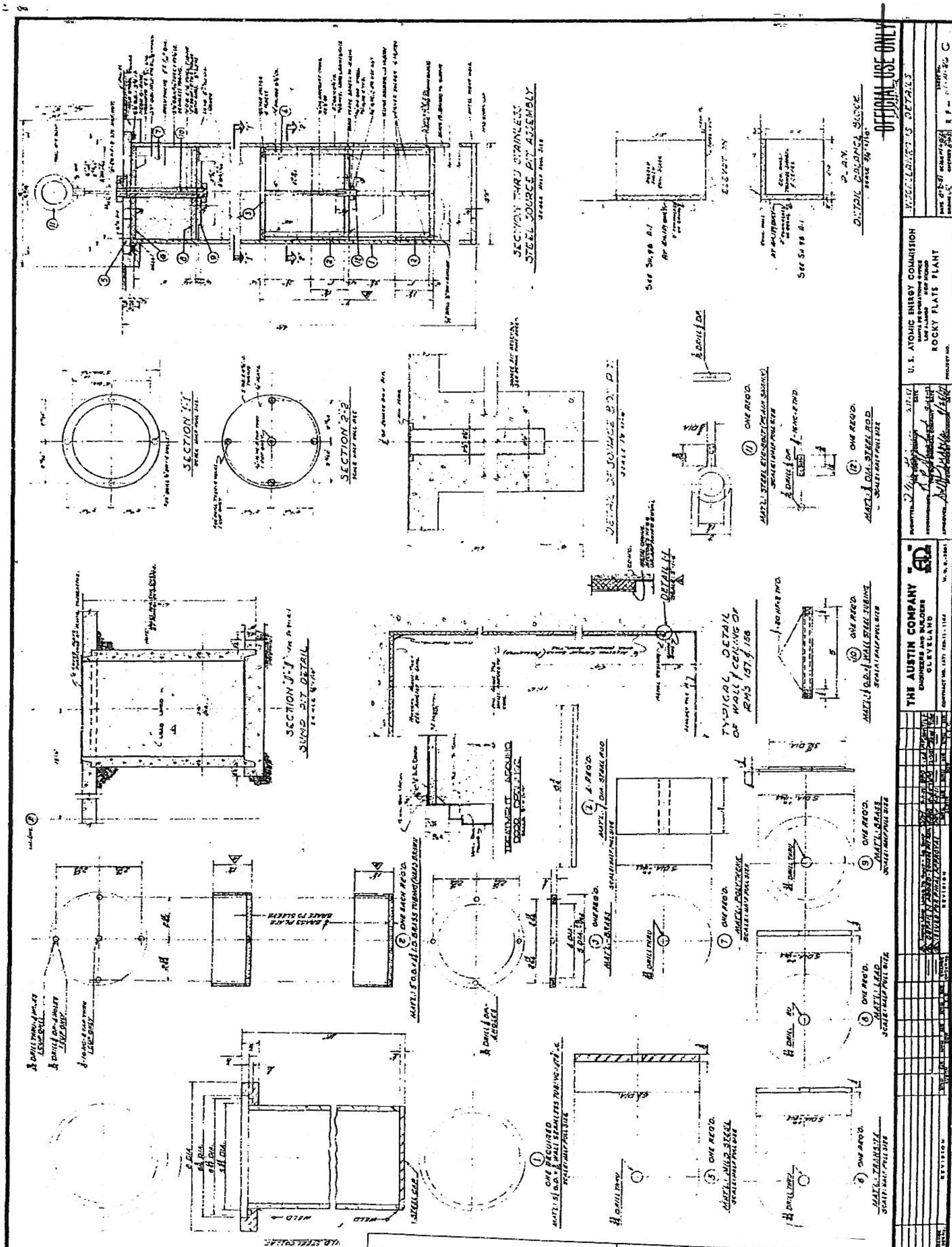

REINFORCEMENT SCHEDULE
SECTION - A - A
SECTION - B - B
SECTION C - C
TUNNEL ENTRANCE PLAN
PLAN OF TUNNEL & BUILDING No. 98
BUILDING No. 91
OFFICIAL USE ONLY
THE AUSTIN COMPANY
ENGINEERS AND BUILDERS
CLEVELAND
U. S. ATOMIC ENERGY COMMISSION
ROCKY FLATS PLANT
CONCRETE TUNNEL
BUILDING No. 98
DECLASSIFICATION REVIEW
1ST REVIEW DATE: 10-15-08
AUTHORITY: ☐ ADC ☒ ADC ☒ ADD
NAME: J.A. NESHEIM
2ND REVIEW - DATE: N/A
AUTHORITY: ADD
NAME:
DETERMINATION [CIRCLE NUMBER(S)]
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFIED CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): UNCLASSIFIED
RFETS B998 DWG. No. & DISCIPLINE (00502-001R) (BLDG)



RFETS. B998 DWG. NO. & DISCIPLINE (38072-001) (BLDG.)

Reviewing Official: [signature]
Date: 10-15-08

DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION



DECLASSIFICATION REVIEW

1ST REVIEW DATE: 10-16-08

AUTHORITY: AOC ☒ ADC ☒ ADD

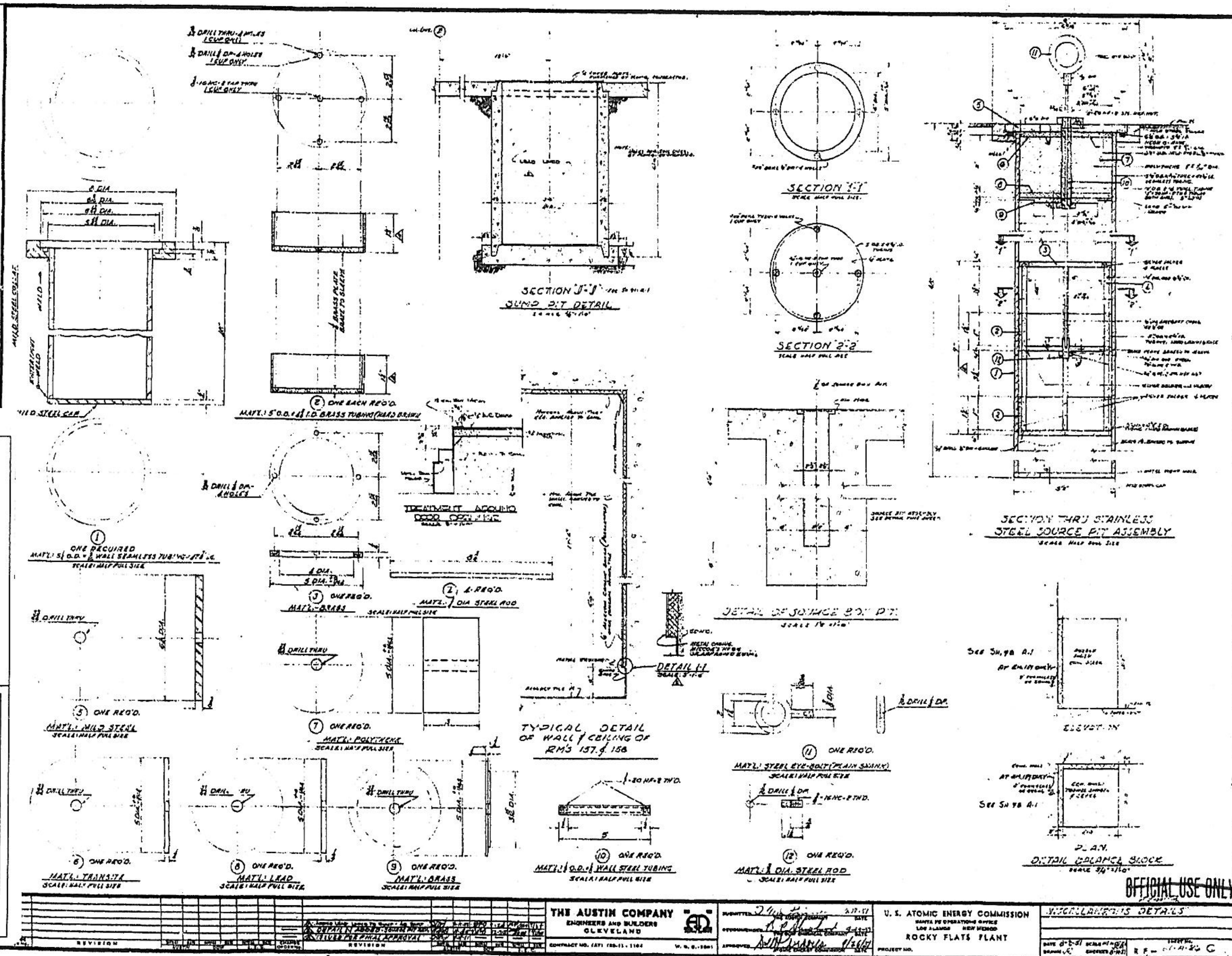
NAME: J.A. NESHEIM

2ND REVIEW - DATE: N/A

AUTHORITY: ADD

NAME:

DETERMINATION [CIRCLE NUMBER(S)]
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): UNCLASSIFIED



RFETS B991 DWG. No. & DISCIPLINE (00A26-001B) (ARCH)

DECLASSIFICATION REVIEW

1ST REVIEW DATE: 10-13-08

AUTHORITY: ☐ AOC ☒ ADC ☒ ADD

NAME: J. A. NESHEIM

2ND REVIEW - DATE: N/A

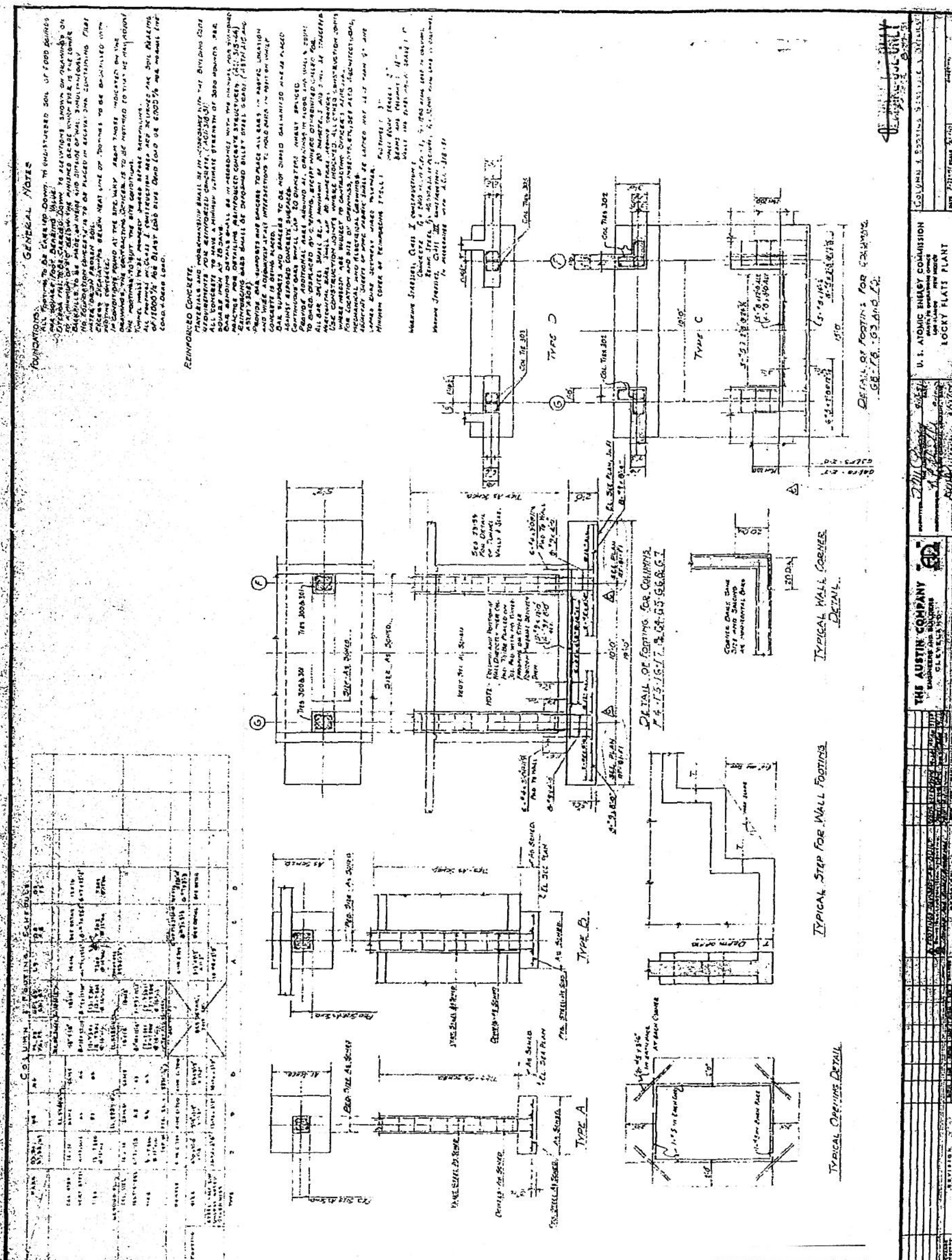
AUTHORITY: ADD

NAME:

DETERMINATION [CIRCLE NUMBER(S)]

1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): UNCLASSIFIED

50



REFS B991 DWG. No. & DISCIPLINE (00F02-001G)(BLDG.)

DECLASSIFICATION REVIEW

1ST REVIEW DATE: 10-16-08

AUTHORITY: ☐ AOC ☒ ADC ☒ ADD

NAME: J.A. NOBLEM

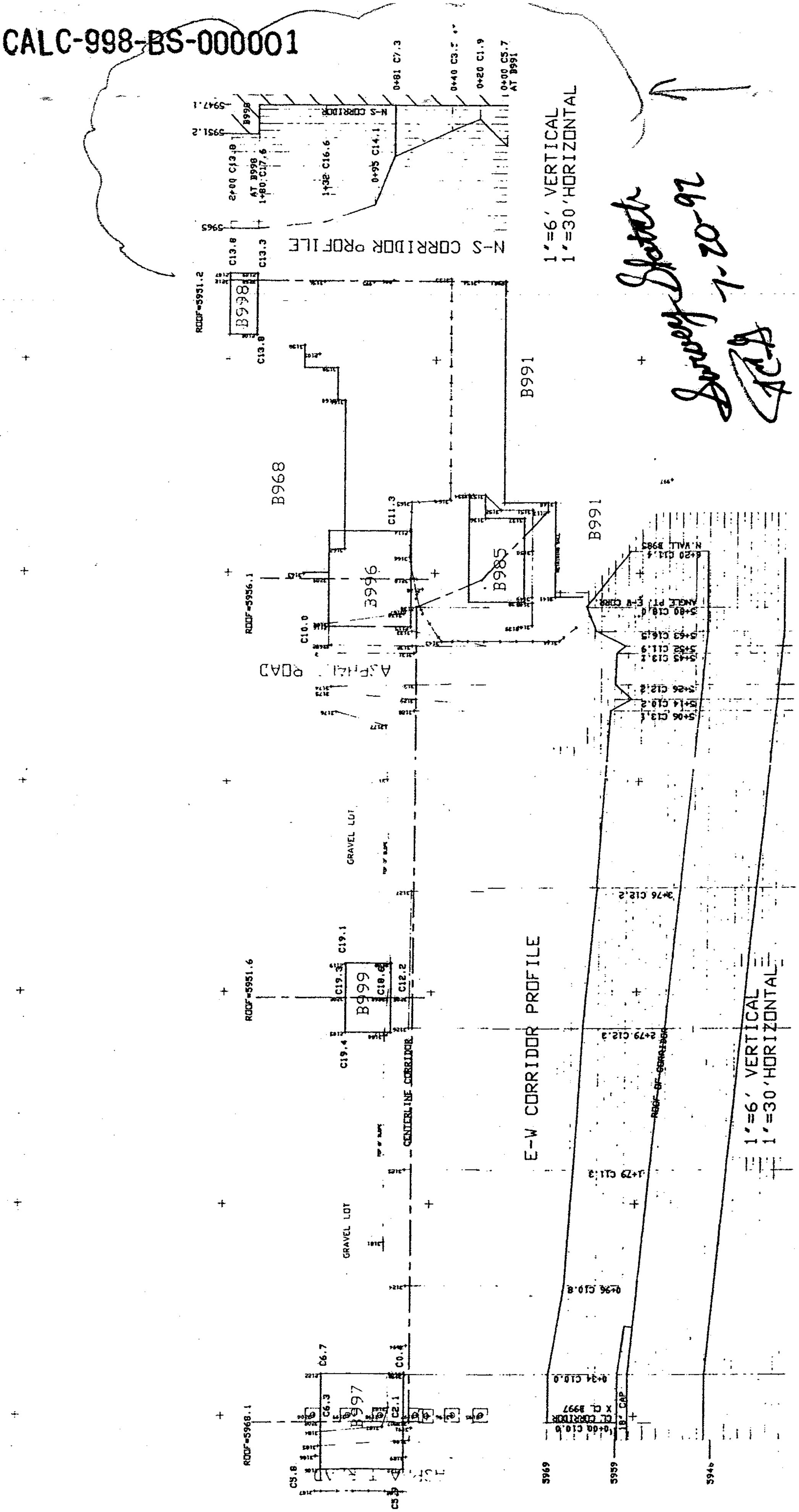
2ND REVIEW - DATE: N/A

AUTHORITY: ADD

NAME:

DETERMINATION [CIRCLE NUMBER(S)]

1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): UNCLASSIFIED



Soil Overburden Survey Datum by PCG (7-20-92)

Attachment
(Bob Prucha, 12/29/2003)

Results of Building 991 and 998 Vault Modeling Simulations

An analysis of the integrated hydrologic and contaminant transport response to the proposed closure configuration associated with Building 991 and the 998 Vault is presented here. Specifically, two concerns raised by the CDPHE are evaluated. The first concern is whether groundwater levels buildup behind subsurface structures (slabs or walls) left in place. Buildup of groundwater levels behind structures in hillslope areas and possible resulting seep areas may increase the potential for slumping and erosion. The second concern is whether VOCs detected in groundwater to the north, migrate into the Building 991 area. Both of these concerns are evaluated using a localized, high-resolution integrated flow model that includes the area associated with Building 991 and the 998 Vault. Conservative conditions are specified within the modeled system to help identify areas that produce the shallowest groundwater levels that may increase the potential for slumping and erosion.

A uniform 25-foot grid resolution was used to simulate the saturated, unsaturated and overland flow processes in the integrated model. Although, surface channel flow was not explicitly simulated in the model, it does not impact the hydrologic conditions within the 991 building area, and an appropriate set of overland flow (non-channelized) and saturated zone boundary conditions could be specified instead. The finer grid resolution permits explicit definition of the Corridor C Tunnel and Vaults 996, 997 and 999. In addition, the integrated model also includes a specific numerical description of the remaining portion of walls and slab for the 991 Building, 998 Vault, and Buildings 984 and 985.

The specific closure configuration for the 991 Building structures and modification to the soil, vegetation and the regraded surface topography were provided by the ER group. For example, the entire subsurface structure associated with Building 984 was assumed removed for closure, while the 991 Tunnel, Vaults 996, 997 and 999, and the 998 Vault were to be left in place. Only those portions of basement walls and slabs Buildings 985 and 991 remaining at least 3 feet below the regraded topographic surface provided by ER remain as well. Remaining portions of buildings 985 and 991 were included in the model to evaluate the collective impact of all structures left in place on the hydraulics surrounding the 991 Tunnel structures.

Hydraulic conditions surrounding the Tunnel system were evaluated using conservative conditions. In other words, any conditions that cause the shallowest groundwater levels in the area were considered. The two primary conservative conditions considered included assuming a wet year climate and that current drains in the area do not operate. The wet year climate is estimated from a 100-year climate sequence as described in the SWWB modeling report (KH, 2002). Current drains including storm, sanitary and footing drains, that lower groundwater levels, were assumed inoperable. The Tunnel structures were assumed to have a low hydraulic conductivity (1e-10 m/s) to simulate the effect of likely leakage through joints and cracks in the concrete.

For each integrated model run, two typical climate years (WY2000) followed by a wet year were simulated. This sequence allows the groundwater system to stabilize to specified initial conditions before responding to a wet year climate sequence. The integrated model runs produce groundwater levels in all model layers and cells continuously (hourly). The simulated mean and minimum annual groundwater levels for the wet year are used to identify areas of the site where groundwater levels are shallow.

Results show that both the mean and minimum annual groundwater depths during the wet year are at least 3 to 4 meters in the vicinity of Building 991 and 998 vault. This is mostly due to the presence of Arapahoe Sandstone and increased depth to bedrock in the area. Groundwater levels over the remaining Building 991 slab also remain greater than 1 meter depth. For average annual conditions, groundwater intercepts the groundsurface along a portion of South Walnut Creek just below Building 991, but is caused by shallow bedrock in this area. For large precipitation events during the wet year, groundwater intercepts ground surface along a greater extent of South Walnut, and north of the 991 Building area near the former Solar Ponds. Transport simulations showed that VOC plume movement from the north into the Building 991 area does not occur, due to the local northerly flow direction in the plume area.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Hydraulic Impacts of Decommissioning Building 991 and Tunnel 998

KAISER-HILL COMPANY, LLC

54

55

Overview

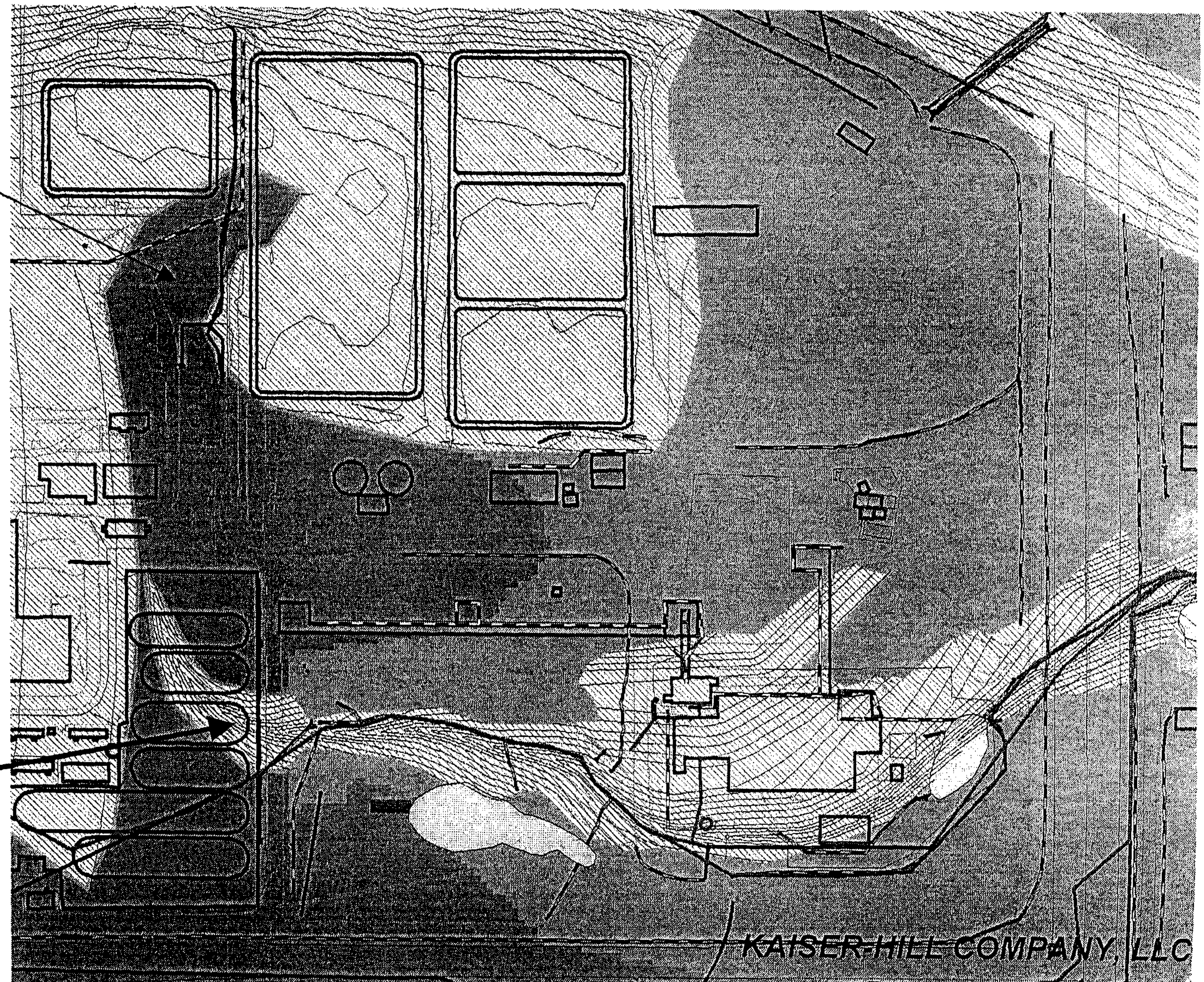
- Model Development
- Conservative Closure Conditions
  - Wet Year Climate
  - No Footing Drains
- Transport Simulation
- Conclusions
- Recommendations

KAISER-HILL COMPANY, LLC

Regraded Area

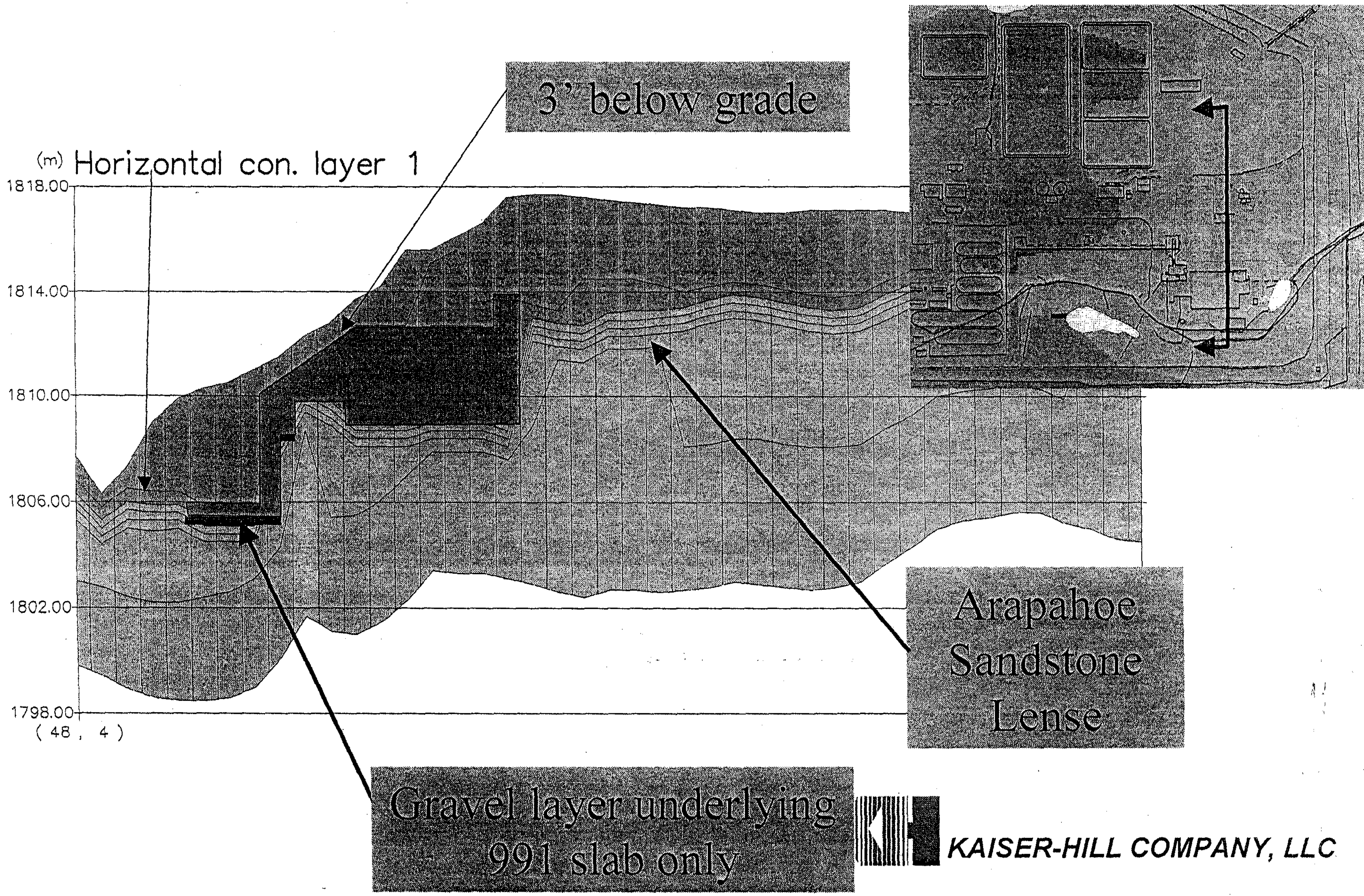
No change in topography (green areas)

Regraded areas shown in white with contours



57

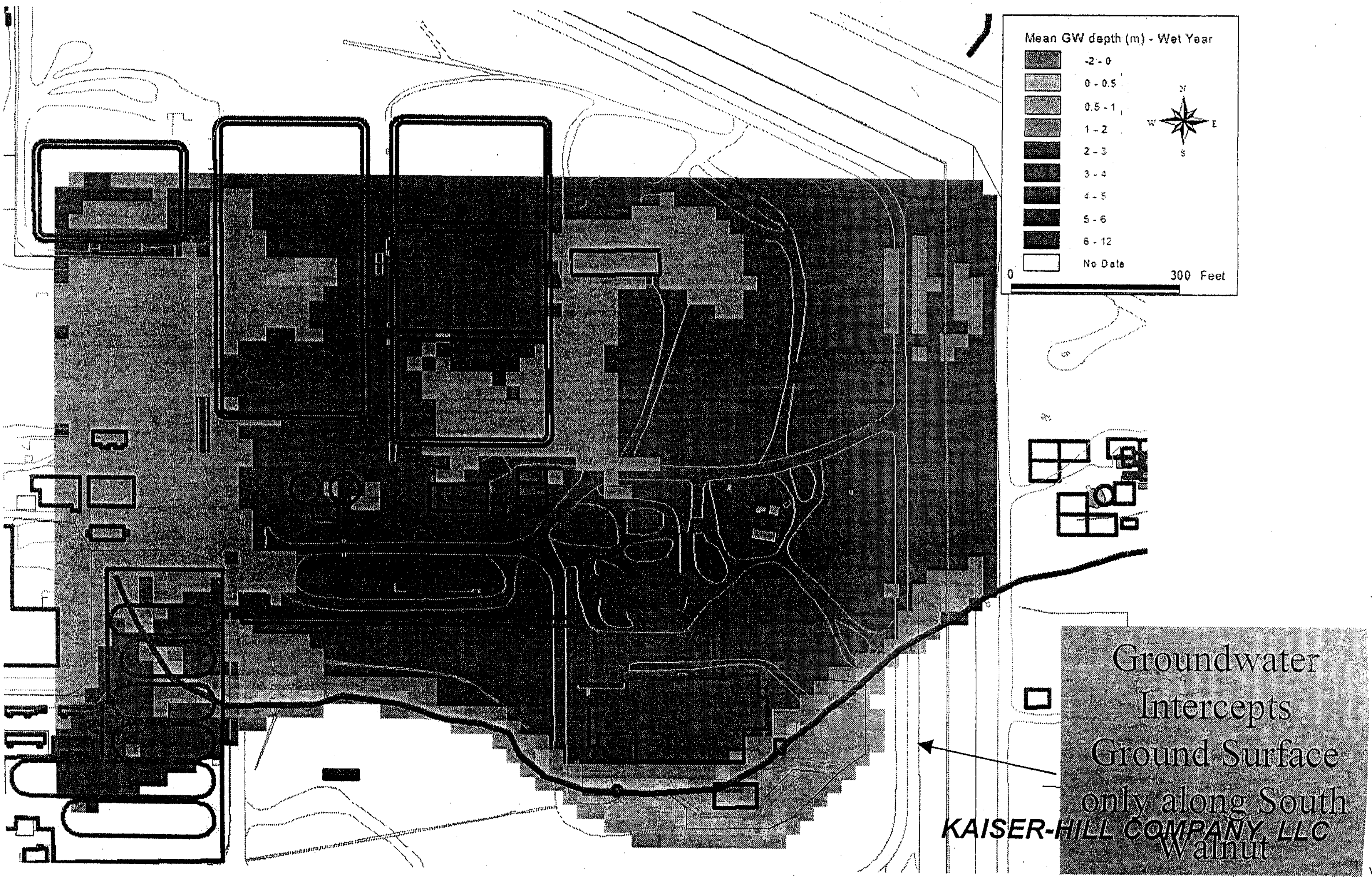
Section through 998 and Building 991



KAISER-HILL COMPANY, LLC

Mean Annual Groundwater Depth (m)

Wet Year, No Footing Drains

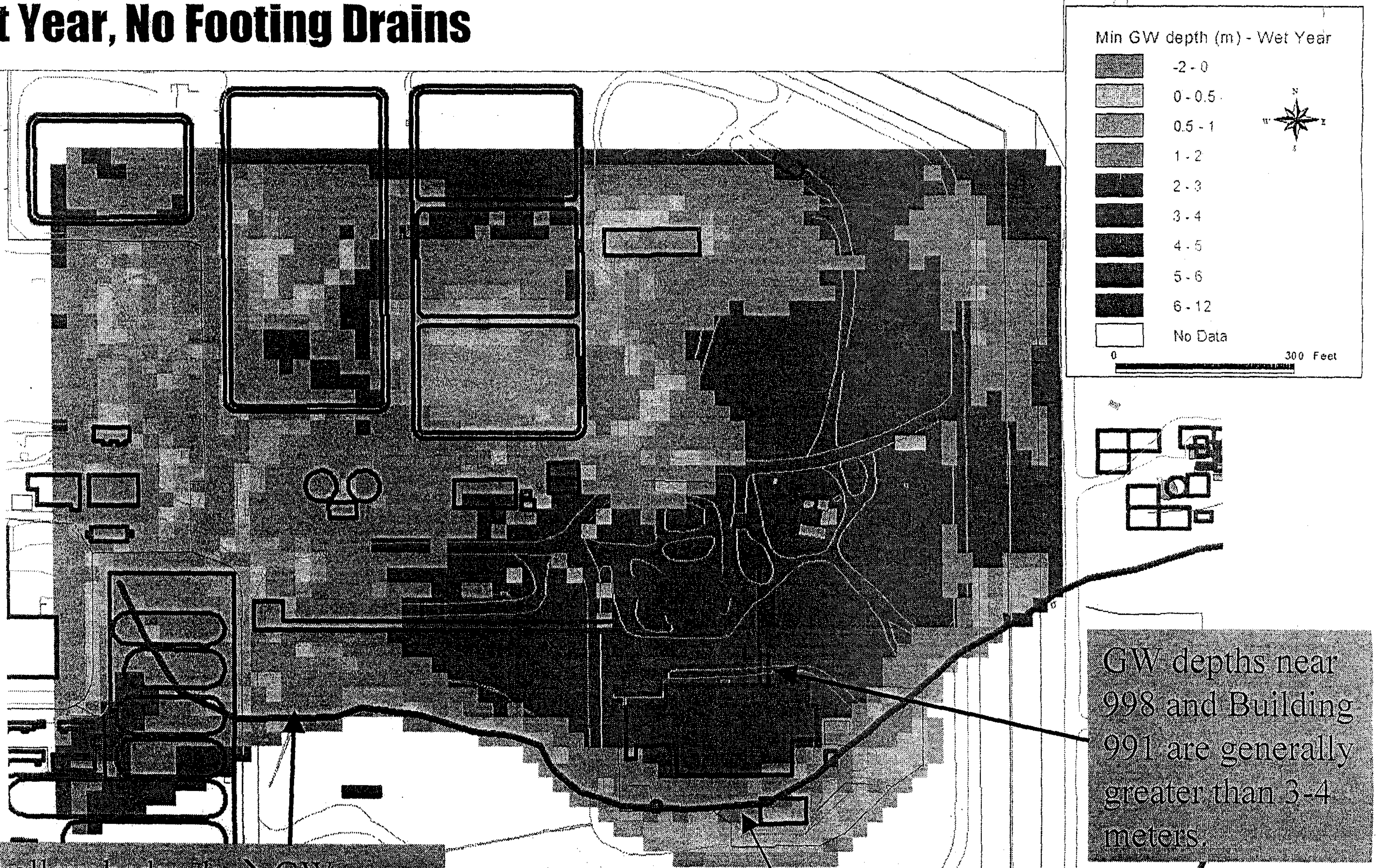


KAISER-HILL COMPANY, LLC

25

59

Minimum Annual GW Depths
Wet Year, No Footing Drains



Shallow dept KAISER-HILL COMPANY, LLC

Conclusions

Conservative Conditions – Wet Year, No Footing Drains

- Groundwater Depths
  - Mean Annual Depths –
    - > 3 to 4 meters below surface around 998 and Building 991
    - Groundwater is shallow at/adjacent to South Walnut Creek just south of Building 991
  - Minimum Annual Depths
    - Still >3 to 4 m below surface around 998 and Building 991
    - More areas within model area exhibit shallow groundwater
- Transport modeling shows (after 200 years) northern VOC plume migrates east and north → no impacts in 991 area
- Vegetation response in wet year → groundwater levels may be lower

KAISER-HILL COMPANY, LLC

Recommendations

- Proposed topographic surface regrade is fine
- Proposed slab/walls associated subsurface building 991 and Tunnel 998 are fine

KAISER-HILL COMPANY, LLC

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 3A
Structural Analysis for Corridor B and Room 402

CALCULATION/OTHER DOCUMENTS COVER SHEET

CALCULATION NUMBER CALC – 991 - BS – 000041 **Rev.** 0

Section 1: IDENTIFICATION

1. WCF or /Authorization Project Number	2. Project Title	3. Page
EFD58300	**B991 CORRIDOR-B TUNNEL AND ROOM (402) STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION**	1 of 31

3. System Identification (See SX-164, Plant System and Component Identification and Labeling)	4. Other (Type of document, e.g., Studies, Conceptual Design Report, Design Criteria, etc.)
NA	Capacity Analysis Calculation

6. Natural Phenomena Hazard Performance Category (PC) Number	7. Building Number
☒ PC-0 / NA ☐ PC-1 ☐ PC-2 ☐ PC-3	B991

8. Engineering Discipline(s) Involved with Calculation:

STRUCTURAL

Section 2: SIGNATURES FOR A CALCULATION

	Discipline	Print Name	Sign	Date
9. Designer(s)	Structural	Keith MacLeod	Keith MacLeod	02/02/04
10. Checker(s)	Structural	Tom Frank	Thomas H Frank	02/03/04
11. Independent Verifier (for PC-0/NA and PC-1)	Structural	Tom Frank	Thomas H Frank	02/03/04
12. Peer Reviewer (for PC-2 and PC-3)	NA			
13. Responsible Engineering Manager	PCE	Tim Humiston	T Humiston	2/03/04
14. Classification Review	SDDC	P.W. SPEYER	PW Speyer U/NU	02/03/04

Section 3: SIGNATURES FOR OTHER DOCUMENTS

	Discipline	Print Name	Sign	Date
15. Preparer				

Section 4: REVISION SUMMARY

16. Description	17. Affected Pages

63

CALCULATION CONTROL NUMBER: CALC – 991 – BS – 000041 - (REV. 0)

1. **IWCP/Authorization Project Number:** **EFD58300**

2. **Calculation Title:** **B991 CORRIDOR-B TUNNELS AND ROOM (402) STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION**

3. **Calculation Description:**

The site is proposing to leave the concrete portions of Corridor-B Tunnels and Room (402) in place and not remove them for the final site closure. Corridor-B starts at B991 by (2) two tunnels and combines to (1) one tunnel that leads to Corridor-C in a "Y" configuration. Corridor-B tunnel is very similar to Corridor-C. Room (402) is between the two branches of Corridor-B.

This calculation addresses two factors that will be involved with this consideration, which are as follows:

1. What is the projected number of years that the tunnel will remain standing before it begins to collapse.
2. What will be the depression in the ground surface when the tunnel does collapse.

Therefore, an analysis of the tunnels and room roof structure present strength and condition is needed to determine what the future long term condition of the tunnel may be. From the structural analysis of the roof, a projection can be made as to how many years before the tunnel begins to collapse. The analysis is based on the tunnel loaded only with the soil overburden that will be the final grade of the site. The tunnel will not be subject to any vehicle traffic. The analysis is also based on the groundwater rising after the footing drains fail, and the tunnel will be exposed to the corrosive effects of water.

4. **Natural Phenomena Hazard Performance Category:** **NA** - It can be reasonably assumed that if an earthquake does occur it will not effect the tunnel, because the tunnel is buried and supported all around by soil.

5. **Calculation Objectives (List):**

The objective is to calculate the strength of the tunnels and room roof structure without steel rebar reinforcement with just the strength of the concrete. This will give an indication of whether the tunnels and room roofs can support its own weight and overburden over a long period of time once the reinforcement has completely corroded. After closure the footing drains are likely to become inoperable over time and the natural groundwater flows are expected to rise. This will expose the tunnels and room to water and the reinforcement will corrode.

Additionally, the objective is to model the effects on the ground surface after the tunnels and room roofs collapse.

CALCULATION CONTROL NUMBER: CALC – 991 – BS – 000041 - (REV. 0)

6. **List Methods used for Calculation:** Standard engineering design practice and by engineering methods of the (ACI) American Concrete Institute.

7. **List Assumptions used:** It is assumed that after a period of time the footing drains will fail and the groundwater will rise, which will expose most of the tunnel the corrosive effects of water. This is based on the report "Hydraulic Effects on Decommissioning Building 997" by Bob Prucha, Integrated Hydro Systems, November 25, 2002.

8. **Identify References:**
   1. ACI 318-89 American Concrete Institute 1989 Edition.
   2. AISC American Institute of Steel Construction, 9th Edition.
   3. "Hydraulic Effects on Decommissioning Building 997" by Bob Prucha, Integrated Hydro Systems, November 25, 2002.
   4. Drawings (attached):
      - 4.1 B996 & B997 Drawings:
        30996-0001-02C, 13810-0001, 13811-0001, 13812-0003, 13812-0005, 13812-0006, & 13812-0007.
      - 4.2 B985 Foundation Drawings – 23493-301, & 23493-303
      - 4.3 B991 Final Grade Drawings – 51754-C130 (Rev.2), 51754-C131 (Rev.2), & 51754-C132 (Rev.2)

9. **Identify Applicable Design Related AB Documents:** **N/A**

10. **Body of Calculation:** Refer to the following calculation pages.

11. **Calculation Conclusion:**

<u>Prediction of Long Term Condition of Building B991 Corridor "B" Tunnels and Room (402)</u>

11.1 <u>Present Strength & Condition of Corridor "B" Tunnels and Room (402)</u>

The Corridor "B" tunnel and Room (402) are in good condition. I have inspected the tunnels and Room (402) and there were no cracks, water seepage, no evidence to corrosion, or settlements that would reduce the strength of the tunnel.

The roof strength of the Tunnels and Room (402) to support the soil overburden after there is a total loss of reinforcement strength due to corrosion is as follows:

a. The Western and main portion of Corridor-B has a roof span = 12 ft. with a thickness = 15". The calculation for this part of the tunnel concludes, the roof **<u>will not</u>** support the soil overburden after the reinforcement corrodes.

b. The Eastern branch portion of the tunnel has a roof span = 8.0 ft. with a thickness = 15", for which the calculation concludes, the roof **<u>will</u>** support the soil overburden after the reinforcement corrodes.

c. Room (402) has a roof span = 19'-4" with a thickness = 18" and the calculation concludes, the roof **cannot** support the soil overburden after the reinforcement corrodes.

A large portion of Corridor-B is covered by the foundation of building B985 (reference B985 Foundation Drawings – 23493-301, & 23493-303). Building B985 foundation and floor slab are supported by concrete piers that were drilled around Corridor-B tunnel. Building B985 foundation and floor slab will be left in place also. The capacity of B985 foundation and floor slab to support the soil overburden was not analyzed, but they will support a considerable amount of the soil overburden. This will delay the collapse of Corridor-B roof. A conservative estimate of the delay would be 200 years.

11.2 Long Term Durability of the Corridor "B" Tunnels and Room (402)

The concrete of the roof of the tunnel and room does **not** have the strength to support its own weight and the soil overburden. Therefore, Corridor-B Tunnels and Room (402) roofs will begin collapsing as the reinforcement becomes completely corroded. Therefore, the long term durability of the tunnel and room is dependent on the time that it will take for the reinforcement to corrode.

The time that it will take for the reinforcement to corrode is based on the following:

1. The hydraulic study concludes that the tunnels and room roofs will be exposed to ground water only part of each year.
2. The concrete of the tunnels and room are in good condition and it will take hundreds of years for the ground water to penetrate the concrete coating around the rebars before corrosion begins.

Once the corrosion of the reinforcement does begin, it will take hundreds of years for the rebar to completely corrode. A conservative estimate of the number of years that it will take for the ground water to penetrate the concrete coating of the reinforcement and to completely corrode the reinforcement would be at least 500 years.

The final strength of the tunnels and room roofs will depend on the uncracked ultimate tensile (rupture) strength of the concrete. The calculations analyzed the roof concrete slabs to determine their capacity for supporting the soil overburden when the reinforcement completely corrodes.

11.3 Conservative Engineering Estimate of the long term condition of Corridor-B Tunnels and Room (402):

1. Western portion of Corridor-B tunnels - Because the roof **cannot** support the weight of soil overburden after the reinforcement completely corrodes, the following can be concluded:

   a. The portion close to Corridor-C and under the foundation of building B985, that will be left in place, will continue to exist without failing for at least **700 years or longer**.

   b. The 20 ft. portion that enters into building B991 will continue to exist without failing for at least **500 years or longer.**

2. Eastern branch portion of the Corridor-B tunnels - Because the roof **can** support the weight of soil overburden after the reinforcement completely corrodes, the tunnel will continue to exist without failing for at least **1,000 to 1,500 years or longer**.

3. Room (402) - Because the roof **cannot** support the weight of soil overburden after the reinforcement completely corrodes, the roof of the room will continue to exist without failing for at least **500 years or longer.**

11.4 Depression in Soil After the Eventual Collapse of Corridor-B Tunnels and Room (402) Roofs

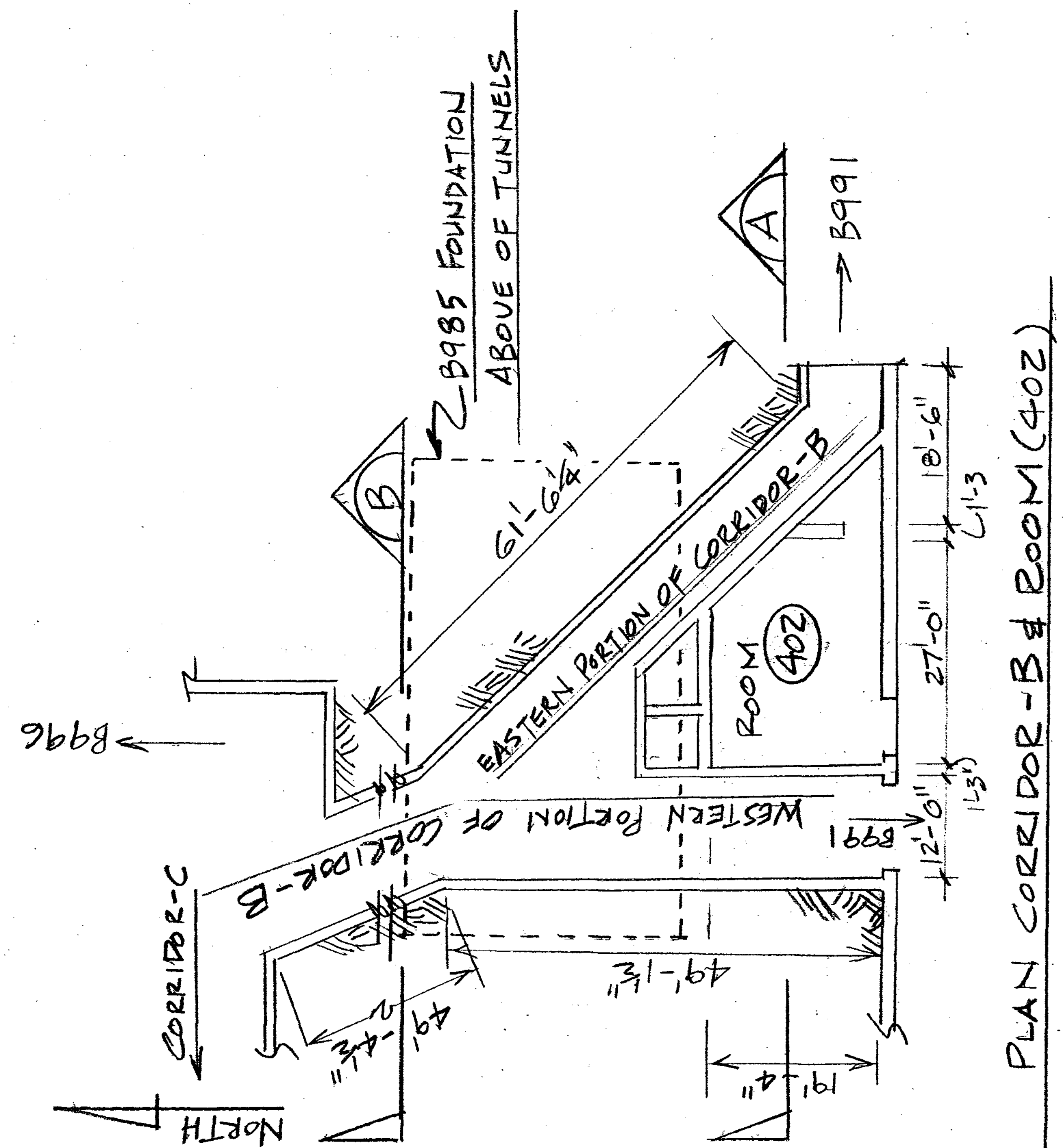
When the tunnel and room roofs do eventually deteriorate and collapse, the soil overburden will fill the tunnels and room and cause a depression on the ground surface. The final depression at the surface will be a trapezoidal shaped trench above the tunnels and a hole at the room. The sides of the depression is assumed to be approximately 45 degree slope (Reference the sketch of the depression on the following pages).

The approximate dimensions of the trapezoidal shaped depressions at ground surface are as follows (Refer to sketch):

1. **Western portion of Corridor-B tunnels –**
   a. **Max. Soil Overburden (the north end of the tunnel at Corridor-C):**
      Dimensions: Depth = 4.0 ft. x 41.5 ft. Wide at Surface
      x 33.5 ft. Wide at Bottom
   b. **Min. Soil Overburden (the south end of the tunnel at B991):**
      Dimensions: Depth = 7.0 ft. x 29.5 ft. Wide at Surface
      x 15.5 ft. Wide at Botto
2. **Eastern branch portion of the Corridor-B tunnels -**
   Dimensions: Depth = 2.5 ft. x 29.5 ft. Wide at Surface
   x 24.5 ft. Wide at Bottom
3. **Room (402) – Total Depression at room:**
   Dimensions: Depth = 12.5 ft. x 27.0 ft. Wide at Surface
   x 19.3 ft. Wide at Bottom

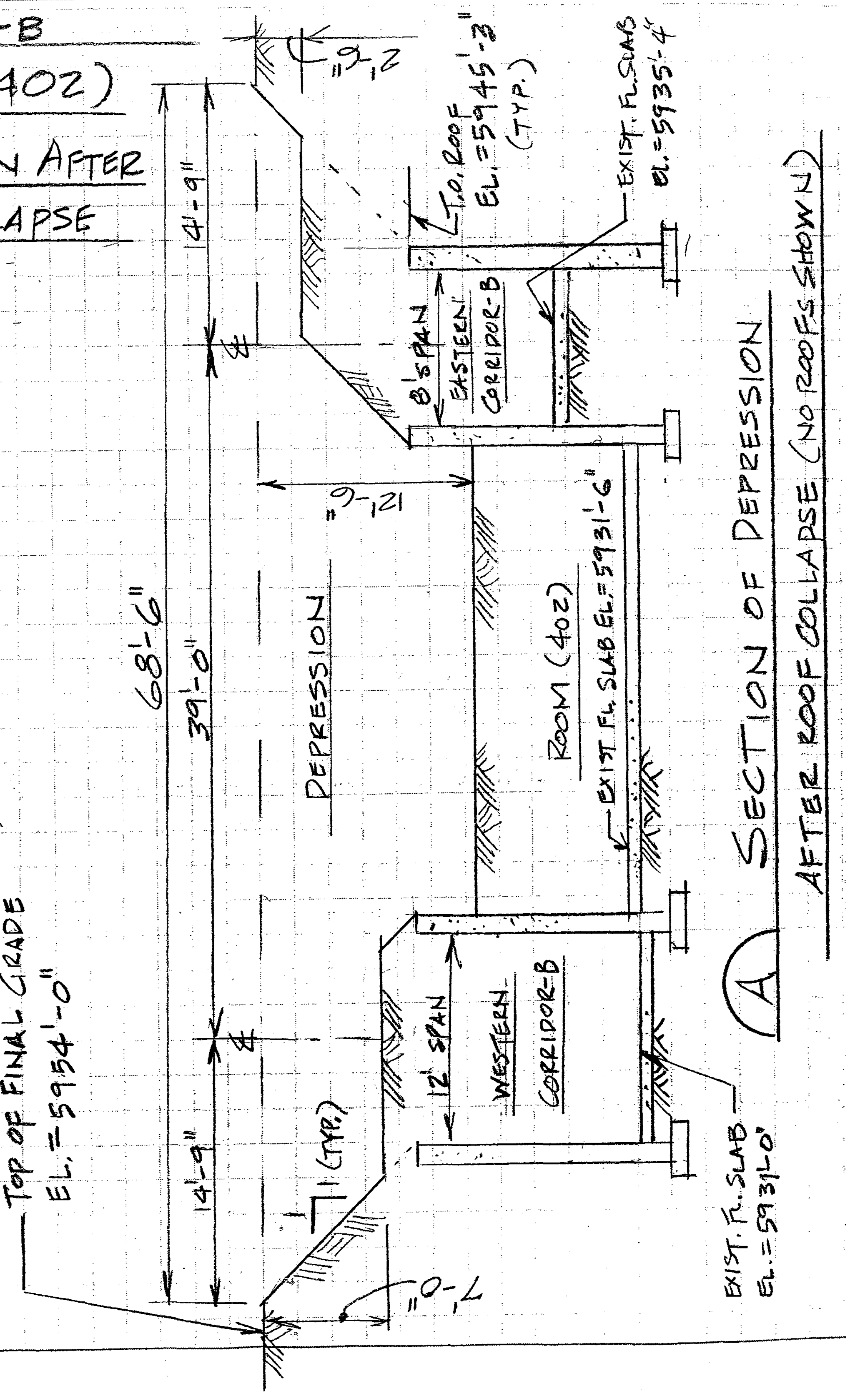
CORRIDOR - B & ROOM (402)

SURFACE DEPRESSIONS AFTER ROOF COLLAPSE



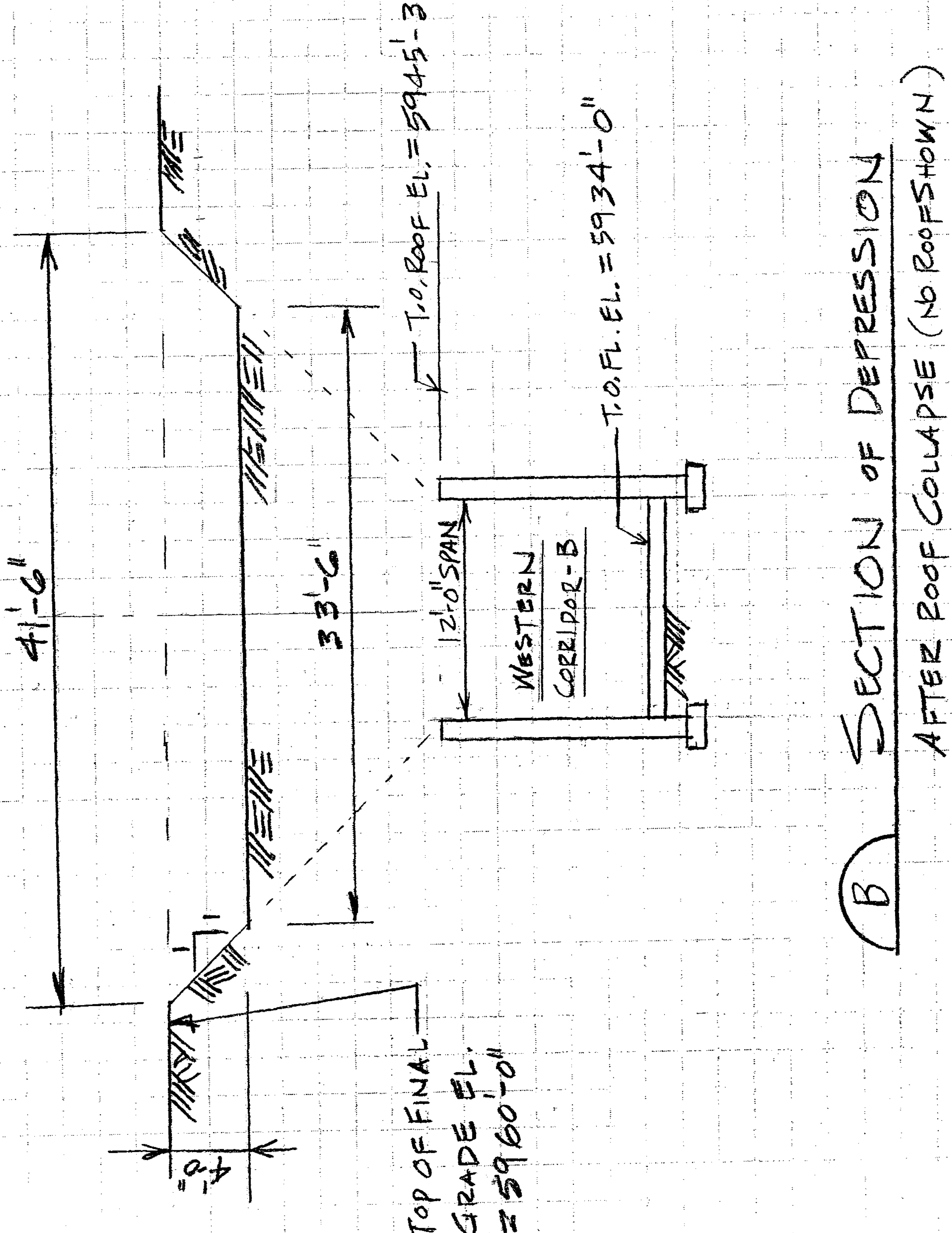
CORRIDOR-B & ROOM (402)

DEPRESSION AFTER ROOF COLLAPSE



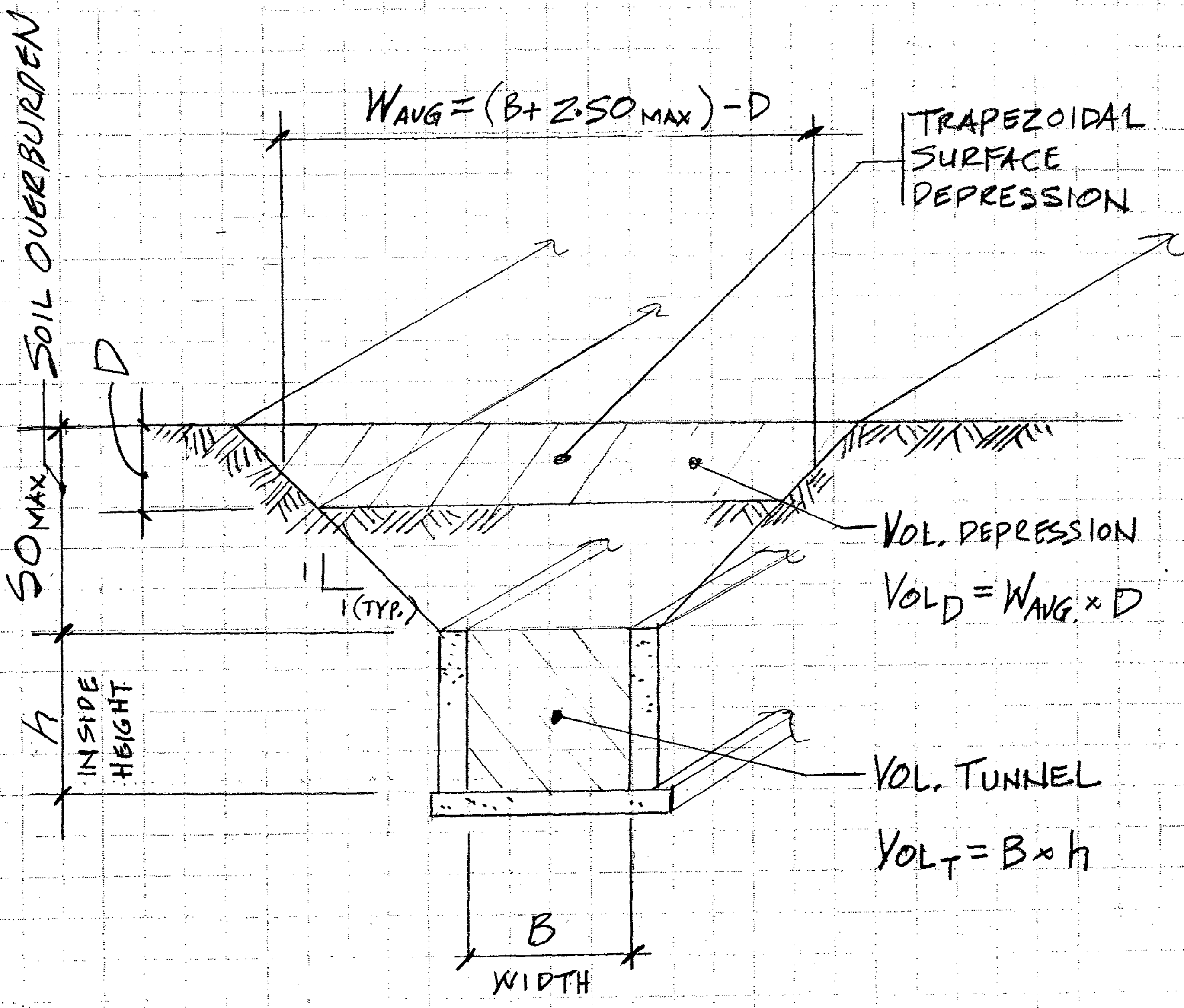
B991 CORRIDOR-B & ROOM (402)

DEPRESSION AFTER ROOF COLLAPSE



B991 CORRIDOR-B & ROOM 402

SURFACE DEPRESSION AFTER COLLAPSE OF ROOF



SECTION THROUGH TUNNEL

SURFACE DEPRESSION (TRAPEZOIDAL SHAPED) AFTER ROOF FAILURE

71

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Refer to Calculation Template Reference Drawings for all calculation values.

$in := ft \cdot 12^{-1}$ $plf := lb \cdot ft^{-1}$ $psf := lb \cdot ft^{-2}$ $pcf := lb \cdot ft^{-3}$ $psi := lb \cdot in^{-2}$

Soil Weight: Dry Soil Weight = 100 pcf
Wet Soil Weight = 120 pcf
Use Soil Weight ===> $\gamma := 110 \cdot pcf$

Concrete Compressive Strength:

(Refer Drawing Building No. 91 Misc. Dets. (RF-91-F-2-C) (RFETS No. 00F02-001G Bldg.)

$f'c := 3000$ lb/sq.in.

Tension (rupture) Capacity of Concrete: (Reference: ACI-318-89 sec. 9.5.23 (9-9) page 97)

$fr := 7.7 \cdot \sqrt{f'c} \cdot psi$ $fr = 421.75\,psi$

Tunnel Soil Overburden:

Top of Tunnel Roof Elevation: $T_{\_rf\_el} := 5945.25 \cdot ft$

Max. and Min. Final Grade Elevations: $T_{Gr\_max} := 5960.0 \cdot ft$ $T_{Gr\_min} := 5954.0 \cdot ft$
(ref. dwgs. 51754-C130, C131, & C132)

Max. and Min. Tunnel Soil Overburden:

$SO_{max} := T_{Gr\_max} - T_{\_rf\_el}$ $\boxed{SO_{max} = 14.75\,ft}$ <<<===

$SO_{min} := T_{Gr\_min} - T_{\_rf\_el}$ $\boxed{SO_{min} = 8.75\,ft}$ <<<===

Tunnel Roof Load:

Tunnel Roof Thickness: $R_{th} := 1.25 \cdot ft$

Max. and Min. Load on Tunnel Roof:

Max. Soil Weight: $S_{wt\_max} := \gamma \cdot SO_{max}$ $S_{wt\_max} = 1622.5\,psf$

Min. Soil Weight: $S_{wt\_min} := \gamma \cdot SO_{min}$ $S_{wt\_min} = 962.5\,psf$

Concrete Weight: $C_{wt} := 150 \cdot pcf \cdot R_{th}$ $C_{wt} = 187.5\,psf$

Max. and Min. Load on Tunnel Roof Per ft. width:

$R_{Ld\_max} := (S_{wt\_max} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld\_max} = 1810\,plf}$ <<<===

$R_{Ld\_min} := (S_{wt\_min} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld\_min} = 1150\,plf}$ <<<===

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Western and Eastern Tunnel Roof Spans:

Tunnel Roof Spans: Western Tunnel: $R_{sp\_w} := 12.0 \cdot ft$

Eastern Tunnel: $R_{sp\_E} := 8.0 \cdot ft$

Max. and Min. Tunnel Roof Soil Overburden Moment Per ft. Width:

(Assume the end supports are between "Fixed" and "Simple") (Ref. AISC pages 2-296 & 2-301)

Western Tunnel: $M_{W\_max} := \dfrac{R_{Ld\_max} \cdot (R_{sp\_w})^2}{10}$ $\boxed{M_{W\_max} = 26064\,lb\,ft}$ <<<====

$M_{W\_min} := \dfrac{R_{Ld\_min} \cdot (R_{sp\_w})^2}{10}$ $\boxed{M_{W\_min} = 16560\,lb\,ft}$ <<<====

Eastern Tunnel: $M_{E\_max} := \dfrac{R_{Ld\_max} \cdot (R_{sp\_E})^2}{10}$ $\boxed{M_{E\_max} = 11584\,lb\,ft}$ <<<====

$M_{E\_min} := \dfrac{R_{Ld\_min} \cdot (R_{sp\_E})^2}{10}$ $\boxed{M_{E\_min} = 7360\,lb\,ft}$ <<<====

Tunnel Roof Strength Capacity Without Reinforcement:

Tunnel Roof Thickness: $R_{th} := 15 \cdot in$

Section Modulus of Roof Per ft. Width: $S_R := \dfrac{12 \cdot in \cdot (R_{th})^2}{6}$ $S_R = 450\,in^3$

Tunnel Roof Cracking Moment: $\boxed{M_{CR} := fr \cdot S_R}$

(Concrete Tension Rupture Capacity times Section Modulus)

Western Tunnel: $M_{CR} = 15815.49\,lb\,ft$ $<$ $\boxed{M_{W\_min} = 16560\,lb\,ft}$ <<<==== Will Collapse

Western Tunnel Roof Cracking Moment is Less than Soil Overburden Roof Moment Therefore, the Western Tunnel Concrete Roof will collapse without reinforcement

Eastern Tunnel: $M_{CR} = 15815.49\,lb\,ft$ $>$ $\boxed{M_{E\_max} = 11584\,lb\,ft}$ <<<==== **O.K.**

Eastern Tunnel Roof Cracking Moment is Larger than Soil Overburden Roof Moment Therefore, the Eastern Tunnel Concrete Roof will not collapse without reinforcement

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod

Project Number: EFD58300

Refer to Calculation Template References Drawings for all calculation values.
Refer to Tunnel Depression Sketch

Western Tunnel Depression After Tunnels Collapse:

(Assume the sides of the soil depression settles at 45 degrees)

Top of Western and Eastern Tunnels Roof Elevation: $T_{\_rf\_el} := 5945.25 \cdot ft$

Top of Tunnel Floor Elevation (varies): $T_{\_flr\_el\_max} := 5934.0 \cdot ft$ to $T_{\_flr\_el\_min} := 5931.0 \cdot ft$

Tunnel Roof Thickness: $R_{th} := 1.25 \cdot ft$

Tunnel Inside Dimensions:

Max Inside Height: $h := T_{\_rf\_el} - R_{th} - T_{\_flr\_el\_min}$ $h = 13\,ft$

Western Tunnel Width: $B_W := 12.0 \cdot ft$

Eastern Tunnel Width: $B_E := 8.0 \cdot ft$

Max. and Min. Final Grade Elevations: $T_{Gr\_max} := 5960.0 \cdot ft$ $T_{Gr\_min} := 5954.0 \cdot ft$
(ref. dwgs. 51754-C130, C131, & C132)

Max. and Min. Tunnel Soil Overburden:

$SO_{max} := T_{Gr\_max} - T_{\_rf\_el}$ $SO_{max} = 14.75\,ft$ <<<===

$SO_{min} := T_{Gr\_min} - T_{\_rf\_el}$ $SO_{min} = 8.75\,ft$ <<<===

Western Tunnel Inside Volume:

$W\_Vol_T := B_W \cdot h$ $\boxed{W\_Vol_T = 156\,ft^2}$ <==

74

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Western Tunnel Depression at Max. Soil Overburden (SOmax) after Roof Collapses:

Depth of the Depression is determined by the following condition:
>>> Depression Volume = Tunnel Inside Volume <<<

Note: If there is not enough soil overburden to fill the tunnel or room after the roof collapses, there will be a hole at the tunnel or room.

Depression Depth at SOmax: **Try Depth of Depression:** $\boxed{D_{max} := 4.0 \cdot ft}$ <==

Average Width of Depression at SOmax: $W_{avg\_max} := \left(B_W + 2 \cdot SO_{max}\right) - D_{max}$

$W_{avg\_max} = 37.5\,ft$

Western Tunnel Volume of Depression at SOmax after Roof Collapses:

Volume of Depression at SOmax:

$Vol_{D\_Max} := W_{avg\_max} \cdot D_{max}$ $Vol_{D\_Max} = 150\,ft^2$ = $W\_Vol_T = 156\,ft^2$ <<=== O.K.

Western Tunnel Depression Widths at Max. Soil Overburden after Roof Collapses:

Depression Width At Surface at SOmax:

$W_{sur\_at\_SOmax} := \left(B_W + 2 \cdot SO_{max}\right)$ $W_{sur\_at\_SOmax} = 41.5\,ft$

Depression Width At Bottom at SOmax:

$W_{Bot\_at\_SOmax} := \left(B_W + 2 \cdot SO_{max}\right) - 2 \cdot D_{max}$ $W_{Bot\_at\_SOmax} = 33.5\,ft$

Western Tunnel Depression at Ground Surface at Max Soil Overburden Will Be Trapezoidal Shaped:

4.0 ft. Deep x 41.5 Wide at Surface To 33.5 ft. Wide At the Bottom

Refer to Sketch

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod

Project Number: EFD58300

Western Tunnel Depression at Min. Soil Overburden (SOmin) after Roof Collapses:

Depression Depth at SOmin: **Try Depth of Depression:** $\boxed{D_{min} := 7.0 \cdot ft}$ <==

Average Width of Depression at SOmin: $W_{avg\_min} := \left(B_W + 2 \cdot SO_{min}\right) - D_{min}$

$W_{avg\_min} = 22.5\,ft$

Western Tunnel Volume of Depression at SOmin after Roof Collapses:

Volume of Depression at SOmin:

$Vol_{D\_Min} := W_{avg\_min} \cdot D_{min}$ $Vol_{D\_Min} = 157.5\,ft^2$ = $W\_Vol_T = 156\,ft^2$ <== O.K.

Western Tunnel Depression Widths at Min. Soil Overburden after Roof Collapses:

Depression Width At Surface at SOmax:

$W_{sur\_at\_SOmin} := \left(B_W + 2 \cdot SO_{min}\right)$ $W_{sur\_at\_SOmin} = 29.5\,ft$

Depression Width At Bottom at SOmax:

$W_{Bot\_at\_SOmin} := \left(B_W + 2 \cdot SO_{min}\right) - 2 \cdot D_{min}$ $W_{Bot\_at\_SOmin} = 15.5\,ft$

Western Tunnel Depression at Ground Surface at Min. Soil Overburden Will Be Trapezoidal Shaped:

7.0 ft. Deep x 29.5 Wide at Surface To 15.5 ft. Wide At the Bottom

(Note: Dmin < SOmin, therefore there will be no hole at tunnel)

Refer to Sketch

B991 ROOM (402) STRUCTURAL ANALYSISFOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod
Project Number: EFD58300

Refer to Calculation Template Reference Drawings for all calculation values.

$in := ft \cdot 12^{-1}$ $plf := lb \cdot ft^{-1}$ $psf := lb \cdot ft^{-2}$ $pcf := lb \cdot ft^{-3}$ $psi := lb \cdot in^{-2}$

Soil Weight: Dry Soil Weight = 100 pcf
Wet Soil Weight = 120 pcf
Use Soil Weight ===> $\gamma := 110 \cdot pcf$

Concrete Compressive Strength:

(Refer Drawing Building No. 91 Misc. Dets. (RF-91-F-2-C) (RFETS No. 00F02-001G Bldg.)

$f'c := 3000$ lb/sq.in.

Tension (rupture) Capacity of Concrete:

(Reference: ACI-318-89 sec. 9.5.23 (9-9) page 97)

$fr := 7.7 \cdot \sqrt{f'c} \cdot psi$ $fr = 421.75\,psi$

Room (402) Soil Overburden:

Top of Room (402) Roof Elevation: $T_{\_rf\_el} := 5945.5 \cdot ft$

Min. Final Grade Elevations:
(ref. dwgs. 51754-C130, C131, & C132)

$T_{Gr\_max} := 5956.0 \cdot ft$ $T_{Gr\_min} := 5954.0 \cdot ft$

Max. and Min. Tunnel Soil Overburden:

$SO_{max} := T_{Gr\_max} - T_{\_rf\_el}$ $\boxed{SO_{max} = 10.5\,ft}$ <<<===

$SO_{min} := T_{Gr\_min} - T_{\_rf\_el}$ $\boxed{SO_{min} = 8.5\,ft}$ <<<===

Room (402) Roof Load:

Tunnel Roof Thickness: $R_{th} := 1.5 \cdot ft$

Max. and Min. Load on Tunnel Roof:

Max. Soil Weight: $S_{wt\_max} := \gamma \cdot SO_{max}$ $S_{wt\_max} = 1155\,psf$

Min. Soil Weight: $S_{wt\_min} := \gamma \cdot SO_{min}$ $S_{wt\_min} = 935\,psf$

Concrete Weight: $C_{wt} := 150 \cdot pcf \cdot R_{th}$ $C_{wt} = 225\,psf$

Max. and Min. Load on Tunnel Roof Per ft. width:

$R_{Ld\_max} := (S_{wt\_max} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld\_max} = 1380\,plf}$ <<<===

$R_{Ld\_min} := (S_{wt\_min} + C_{wt}) \cdot 1 \cdot ft$ $\boxed{R_{Ld\_min} = 1160\,plf}$ <<<===

By: K. MacLeod

Project Number: EFD58300

B991 ROOM (402) STRUCTURAL ANALYSISFOR THE PREDICTION OF LONG TERM CONDITION

Room (402) Roof Span:

Roof Spans: $R_{sp} := 19.3 \cdot ft$

Max. Roof Soil Overburden Moment Per ft. Width:

(Assume the end supports are between "Fixed" and "Simple") (Ref. AISC pages 2-296 & 2-301)

Room (402) Roof Moment: $M_{max} := \dfrac{R_{Ld\_max} \cdot (R_{sp})^2}{10}$ $\boxed{M_{max} = 51403.62\,lb\,ft}$ <<<====

Room (402) Strength Capacity Without Reinforcement:

Room (402) Roof Thickness: $R_{th} := 18 \cdot in$

Section Modulus of Roof Per ft. Width: $S_R := \dfrac{12 \cdot in \cdot (R_{th})^2}{6}$ $S_R = 648\,in^3$

Room (402) Roof Cracking Moment: $\boxed{M_{CR} := fr \cdot S_R}$

(Concrete Tension Rupture Capacity times Section Modulus)

$M_{CR} = 22774.3\,lb\,ft$ $<$ $\boxed{M_{max} = 51403.62\,lb\,ft}$ <<<==== Will Collapse

Room (402) Roof Cracking Moment is Less than Soil Overburden Roof Moment Therefore, the Concrete Roof will collapse without reinforcement

B991 CORRIDOR-B TUNNEL STRUCTURAL ANALYSIS FOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod

Project Number: EFD58300

Refer to Calculation Template References Drawings for all calculation values.
Refer to Tunnel Depression Sketch

Eastern Tunnel Depression After Tunnels Collapse:

(Assume the sides of the soil depression settles at 45 degrees)

Top of Western and Eastern Tunnels Roof Elevation: $T_{\_rf\_el} := 5945.25 \cdot ft$

Top of Tunnel Floor Elevation (varies): $T_{\_flr\_el\_max} := 5935.4 \cdot ft$ $T_{\_flr\_el\_min} := 5934.0 \cdot ft$

Tunnel Roof Thickness: $R_{th} := 1.25 \cdot ft$

Tunnel Inside Dimensions:

Max Inside Height: $h := T_{\_rf\_el} - R_{th} - T_{\_flr\_el\_max}$ $h = 8.6\,ft$

Western Tunnel Width: $B_W := 12.0 \cdot ft$

Eastern Tunnel Width: $B_E := 8.0 \cdot ft$

Max. and Min. Final Grade Elevations: $T_{Gr\_max} := 5956.0 \cdot ft$ $T_{Gr\_min} := 5954.0 \cdot ft$
(ref. dwgs. 51754-C130, C131, & C132)

Max. and Min. Tunnel Soil Overburden:

$SO_{max} := T_{Gr\_max} - T_{\_rf\_el}$ $SO_{max} = 10.75\,ft$ <<<===

$SO_{min} := T_{Gr\_min} - T_{\_rf\_el}$ $SO_{min} = 8.75\,ft$ <<<===

Eastern Tunnel Inside Volume:

$E\_Vol_T := B_E \cdot h$ $\boxed{E\_Vol_T = 68.8\,ft^2}$ <==

By: K. MacLeod
Project Number: EFD58300

Eastern Tunnel Depression at Max. Soil Overburden (SOmax) after Roof Collapses:

Depth of the Depression is determined by the following condition:
>>> Depression Volume = Tunnel Inside Volume <<<

Note: If there is not enough soil overburden to fill the tunnel or room after the roof collapses, there will be a hole at the tunnel or room.

Depression Depth at SOmin: **Try Depth of Depression:** $\boxed{D_{min} := 2.5 \cdot ft}$ <==

Average Width of Depression at SOmin: $W_{avg\_min} := (B_W + 2 \cdot SO_{min}) - D_{min}$

$W_{avg\_min} = 27\,ft$

Eastern Tunnel Volume of Depression at SOmin after Roof Collapses:

Volume of Depression at SOmin:

$Vol_{D\_Min} := W_{avg\_min} \cdot D_{min}$ $Vol_{D\_Min} = 67.5\,ft^2$ = $E\_Vol_T = 68.8\,ft^2$ <<=== O.K.

Eastern Tunnel Depression Widths at Min. Soil Overburden after Roof Collapses:

Depression Width At Surface at SOmin:

$W_{sur\_at\_SOmin} := (B_W + 2 \cdot SO_{min})$ $W_{sur\_at\_SOmin} = 29.5\,ft$

Depression Width At Bottom at SOmax:

$W_{Bot\_at\_SOmin} := (B_W + 2 \cdot SO_{min}) - 2 \cdot D_{min}$ $W_{Bot\_at\_SOmin} = 24.5\,ft$

Eastern Tunnel Depression at Ground Surface at Min. Soil Overburden Will Be Trapezoidal Shaped:

2.5 ft. Deep x 29.5 Wide at Surface To 24.5 ft. Wide At the Bottom

(Note: Dmin < SOmin, therefore there will be no hole at tunnel)

Refer to Sketch

B991 ROOM (402) STRUCTURAL ANALYSISFOR THE PREDICTION OF LONG TERM CONDITION

By: K. MacLeod

Project Number: EFD58300

Refer to Calculation Template References Drawings for all calculation values.
Refer to Room Depression Sketch

Room (402) Depression After Roof Collapses:

Note: As the roofs of Corridor-B and Room (402) collapse, the soil overburden on three (3) sides of Room (402) will be filling the tunnels of Corridor-B. Therefore, Room (402), will only be filled with the soil overburden that is directly above the room.

Top of Room (402) Roof Elevation: $T_{\_rf\_el} := 5945.5 \cdot ft$

Top of Room (402) Floor Elevation: $T_{\_flr\_el} := 5931.5 \cdot ft$

Room (402) Roof Thickness: $R_{th} := 1.5 \cdot ft$

Room (402) Inside Dimensions: $h := T_{\_rf\_el} - R_{th} - T_{\_flr\_el}$ $\quad h = 12.5\,ft$

Room (402) Dimensions: 27.0 ft. x 19.3 ft.

Max. and Min. Final Grade Elevations: $T_{Gr\_max} := 5956.0 \cdot ft$ $\quad T_{Gr\_min} := 5954.0 \cdot ft$
(ref. dwgs. 51754-C130, C131, & C132)

Average Room (402) Soil Overburden plus roof thickness:

$$SO_{avg\_rf} := \frac{\left(T_{Gr\_max} + T_{Gr\_min}\right)}{2} - T_{\_rf\_el} + R_{th} \qquad SO_{avg\_rf} = 11\,ft \quad \text{<<<==}$$

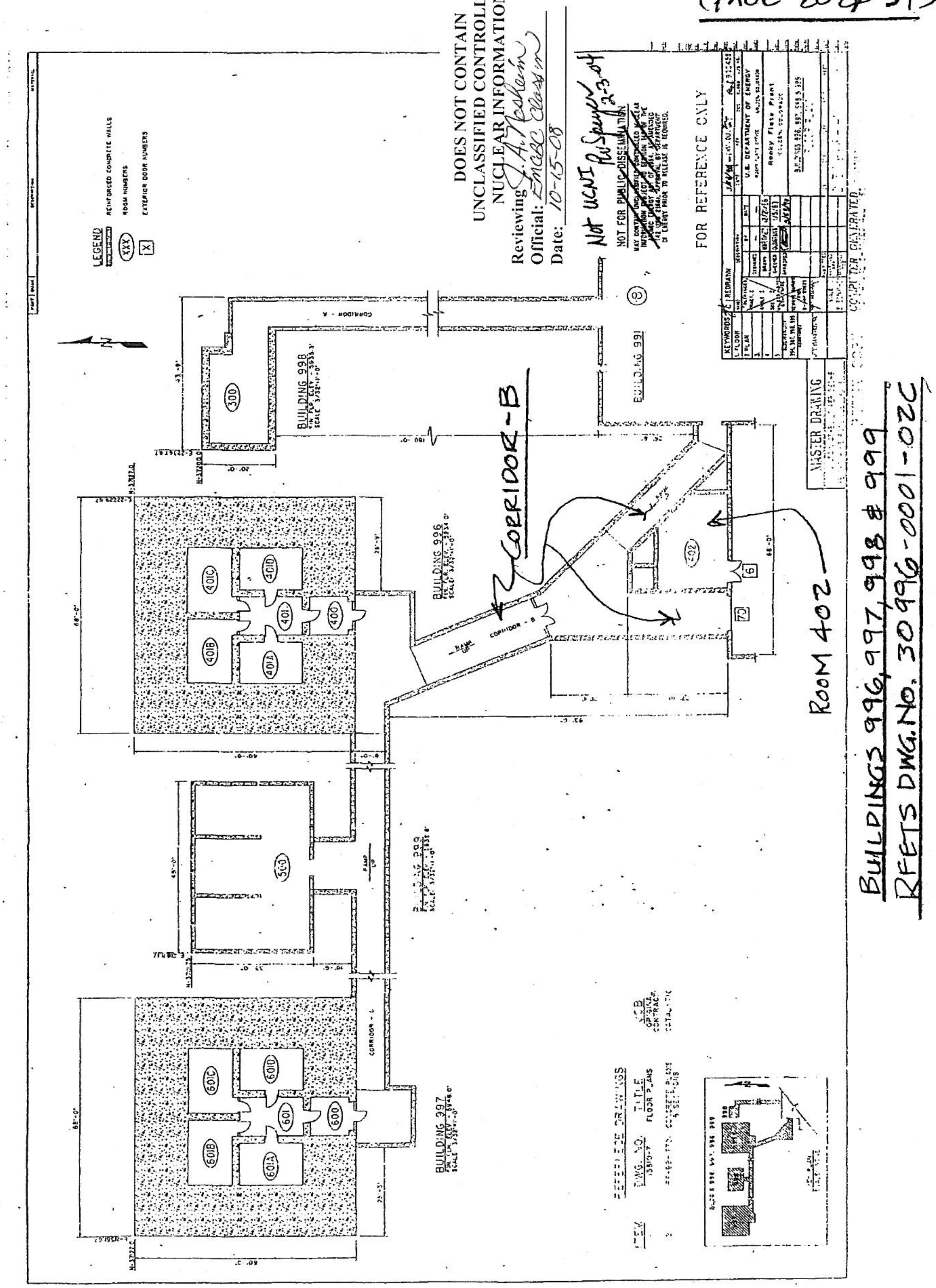
Soil Overburden + Roof Thickness: $SO_{avg\_rf} = 11\,ft$ $<$ $h = 12.5\,ft$ <== **Room Height**

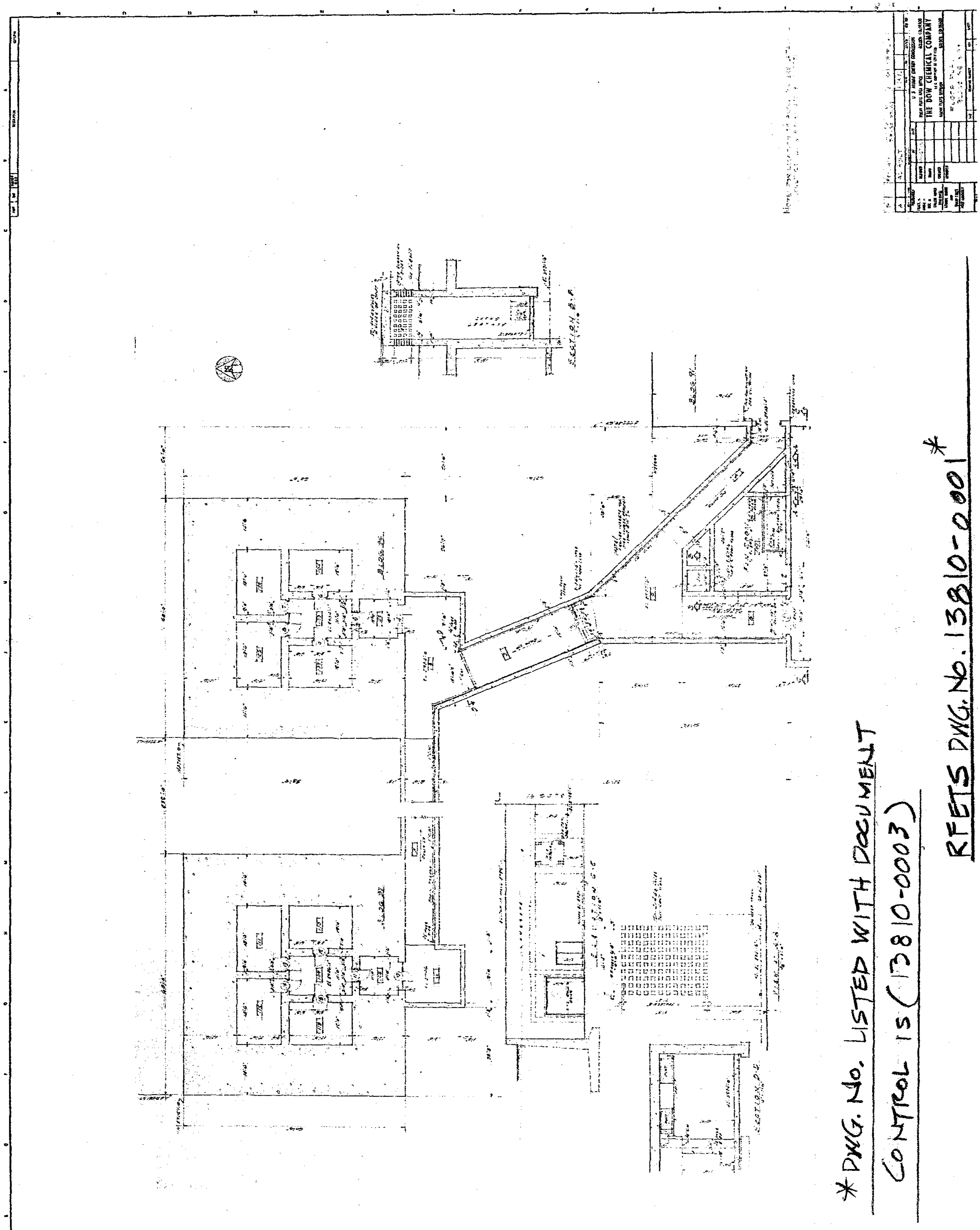
Total Depression: $TD := h$ $\quad \boxed{TD = 12.5\,ft}$ <==

The Final Depression after the roof of Room (402) roof collapses:

Depth = 12.5 ft. x 27.0 ft. x 19.3 ft.

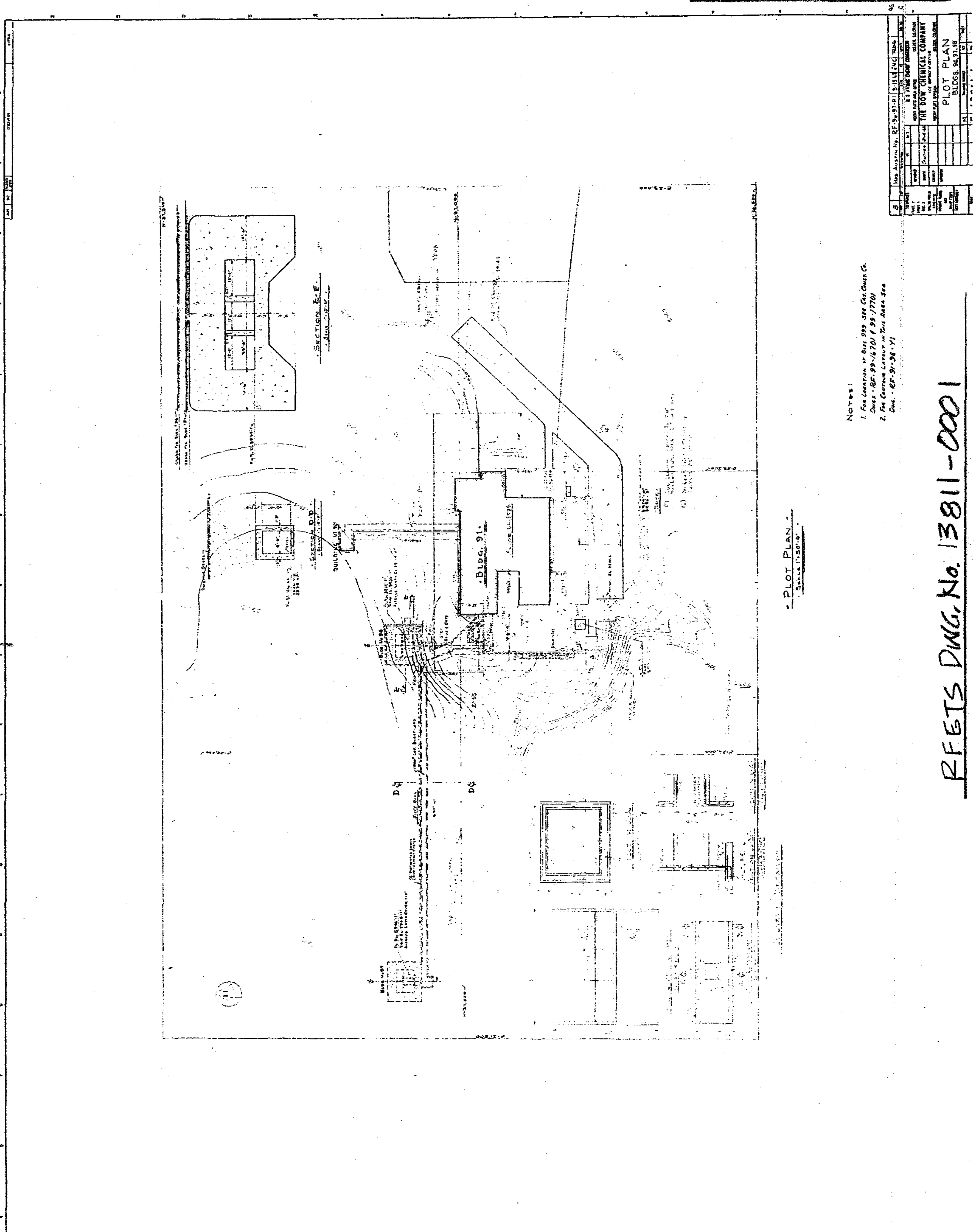
Refer to Sketch

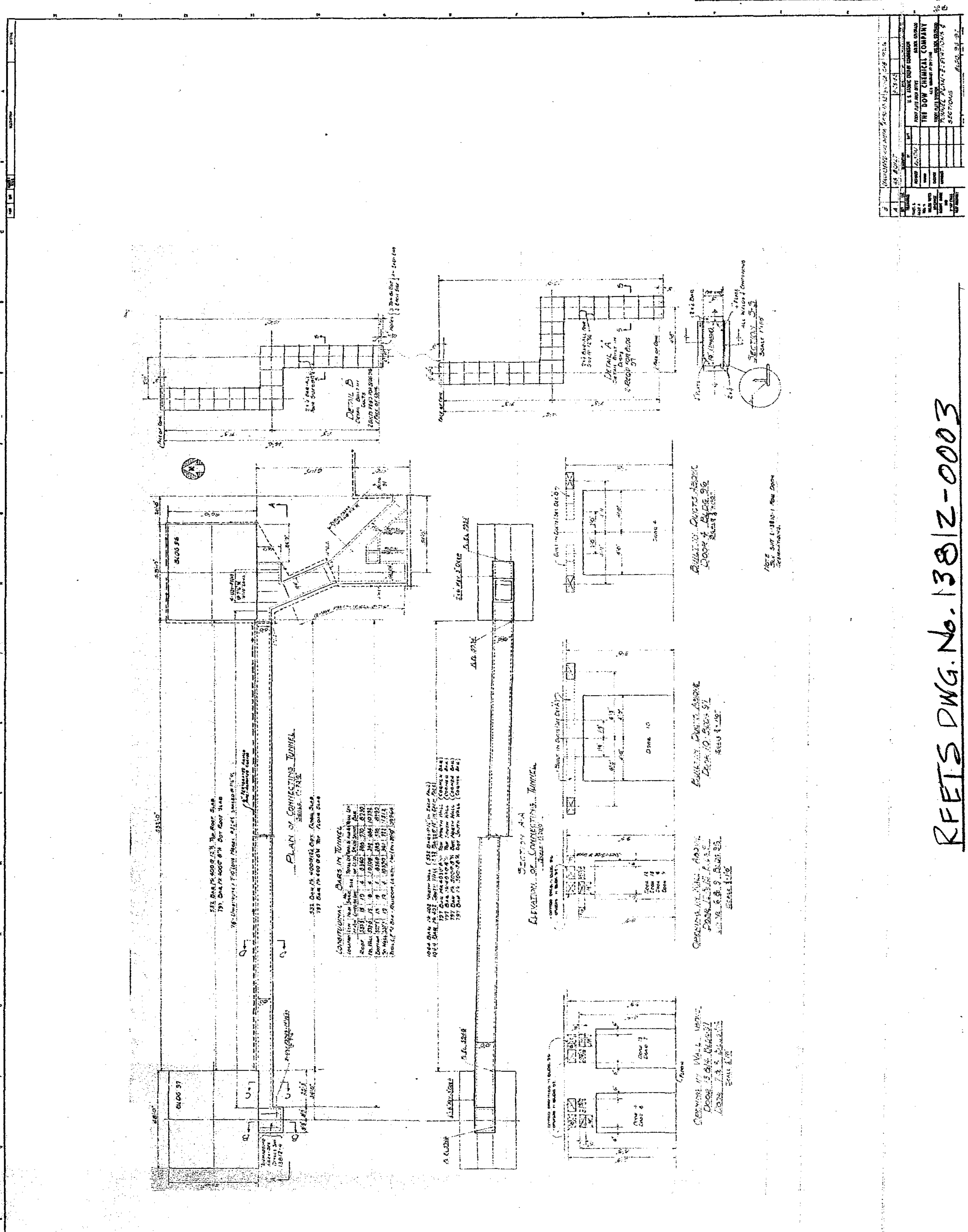

DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
Reviewing Official: J. A. Meshkoin ENCORE Class. M.
Date: 10-15-08
Not UCNI R. Sawyer 12-3-04
NOT FOR PUBLIC DISSEMINATION
FOR REFERENCE ONLY
LEGEND
REINFORCED CONCRETE WALLS
ROOM NUMBERS
EXTERIOR DOOR NUMBERS
CORRIDOR - A
CORRIDOR - B
CORRIDOR - C
BUILDING 998
BUILDING 991
BUILDING 996
BUILDING 999
BUILDING 997
ROOM 402
MASTER DRAWING
U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
REFERENCE DRAWINGS
BUILDINGS 996, 997, 998 & 999
RFETS DWG. NO. 30996-0001-02C



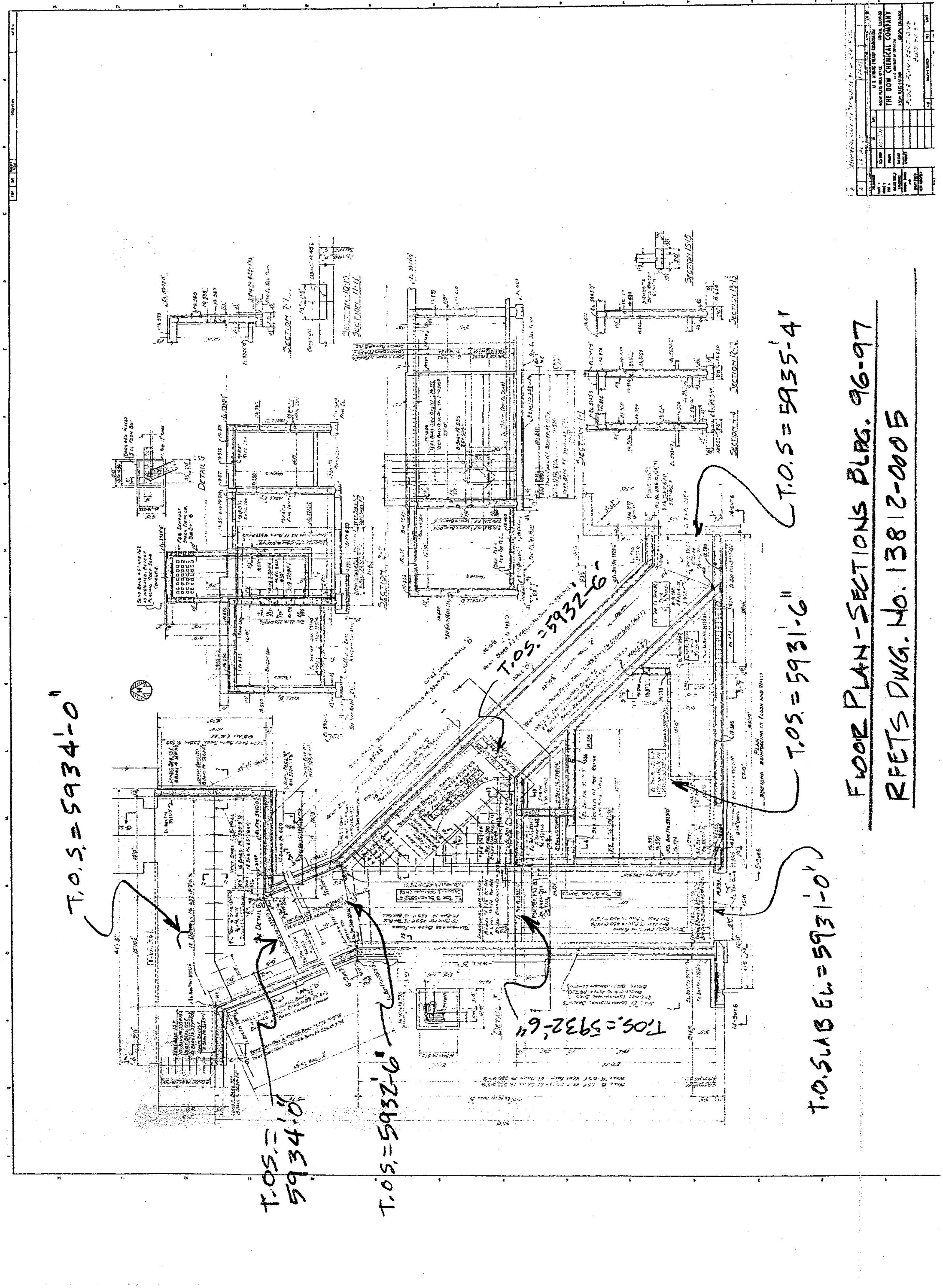
*DWG. No. LISTED WITH DOCUMENT CONTROL IS (13810-0003)

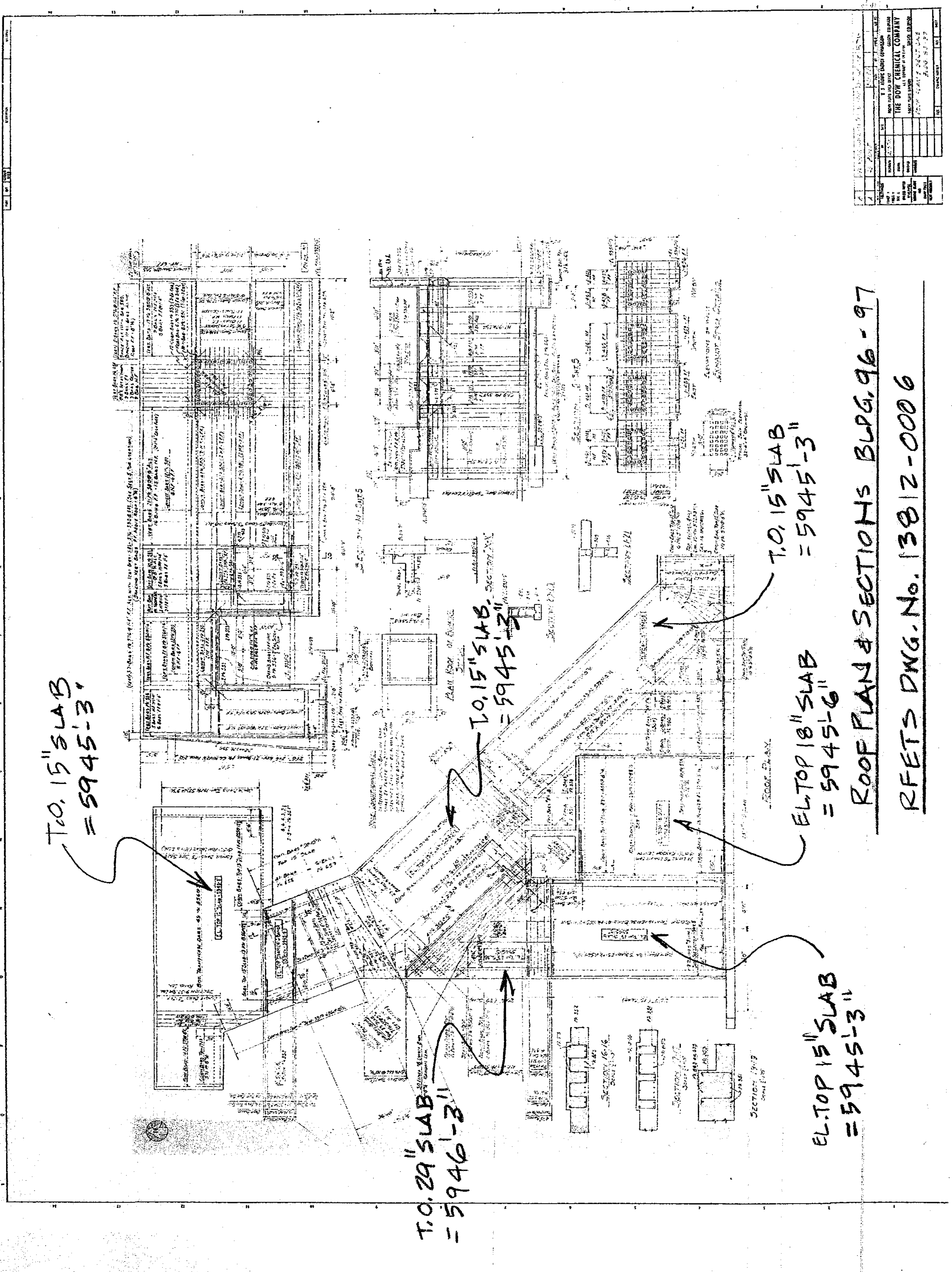
RFETS DWG. No. 13810-0001*

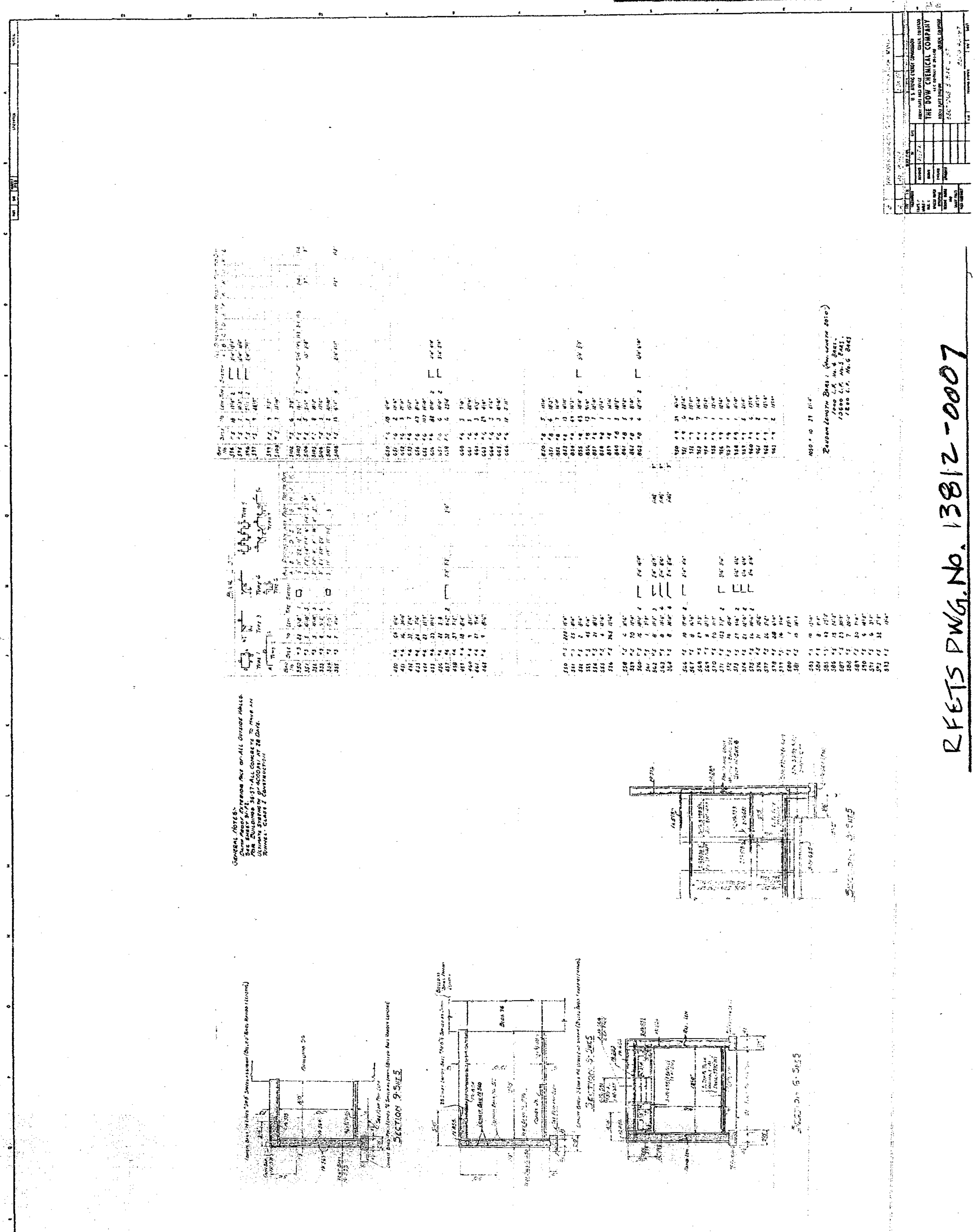

THE DOW CHEMICAL COMPANY
PLOT PLAN
BLDGS. 96, 97, 98
SECTION E-E
SECTION D-D
BLDG. 91
PLOT PLAN
NOTES:
RFETS DWG. No. 13811-0001



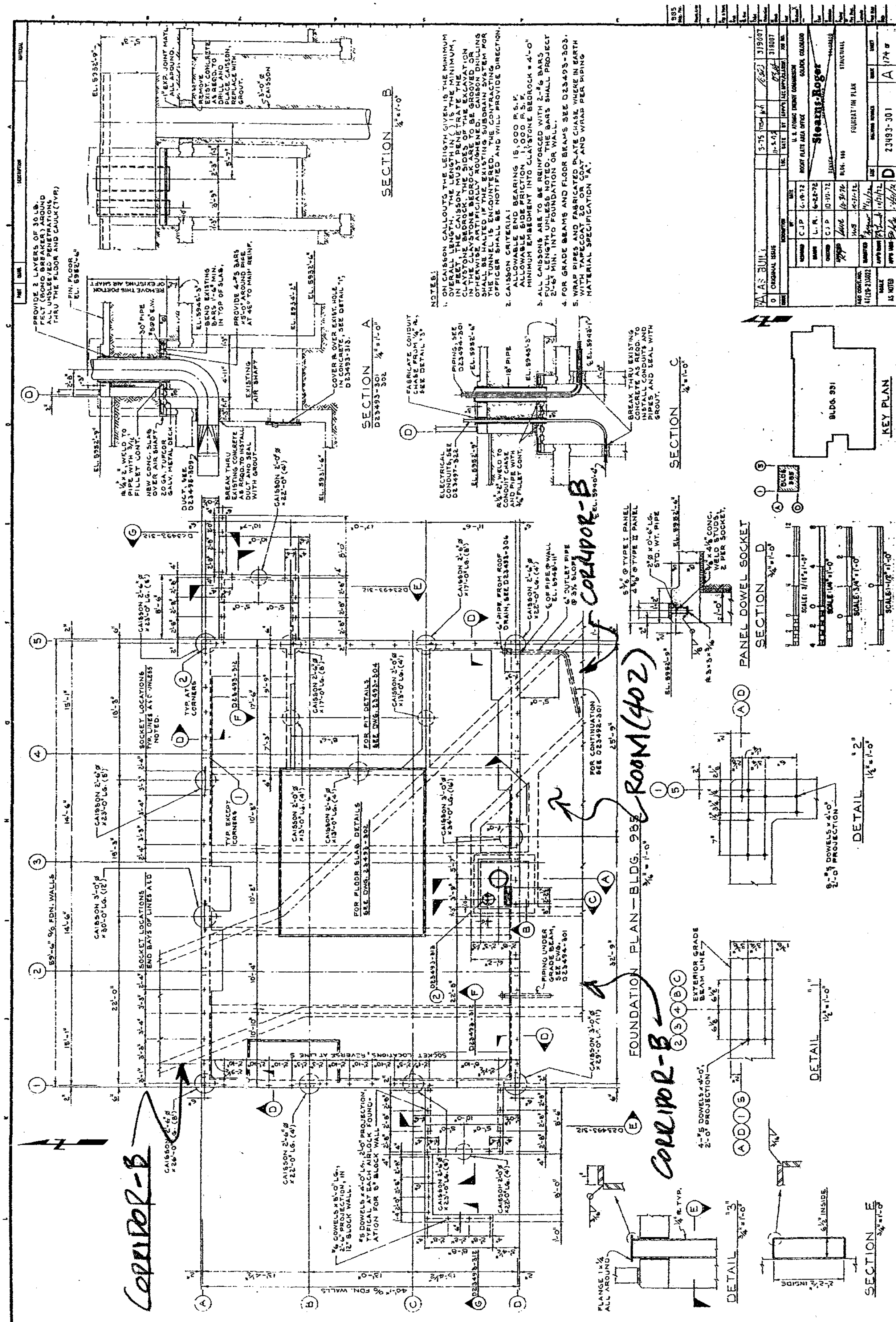
85


FLOOR PLAN-SECTIONS BLDG. 96-97
RFETS DWG. No. 13812-0005
T.O.S.=5935'-4'
T.O.S.=5931'-6"
T.O.SLAB EL.=5931'-0'
T.O.S.=5932'-6"
T.O.S.=5932'-6"
T.O.S.=5934'-0"
T.O.S.=5932'-6"
T.O.S.=1'' 5934'-0"
THE DOW CHEMICAL COMPANY


T.O. 15" SLAB
= 5945'-3"
T.O. 15" SLAB
= 5945'-2"
T.O. 15" SLAB
= 5945'-3"
EL. TOP 18" SLAB
= 5945'-6"
ROOF PLAN & SECTIONS BLDG. 96-97
RFETS DWG. No. 13812-0006
EL. TOP 15" SLAB
= 5945'-3"
T.O. 29" SLAB
= 5946'-3"
THE DOW CHEMICAL COMPANY



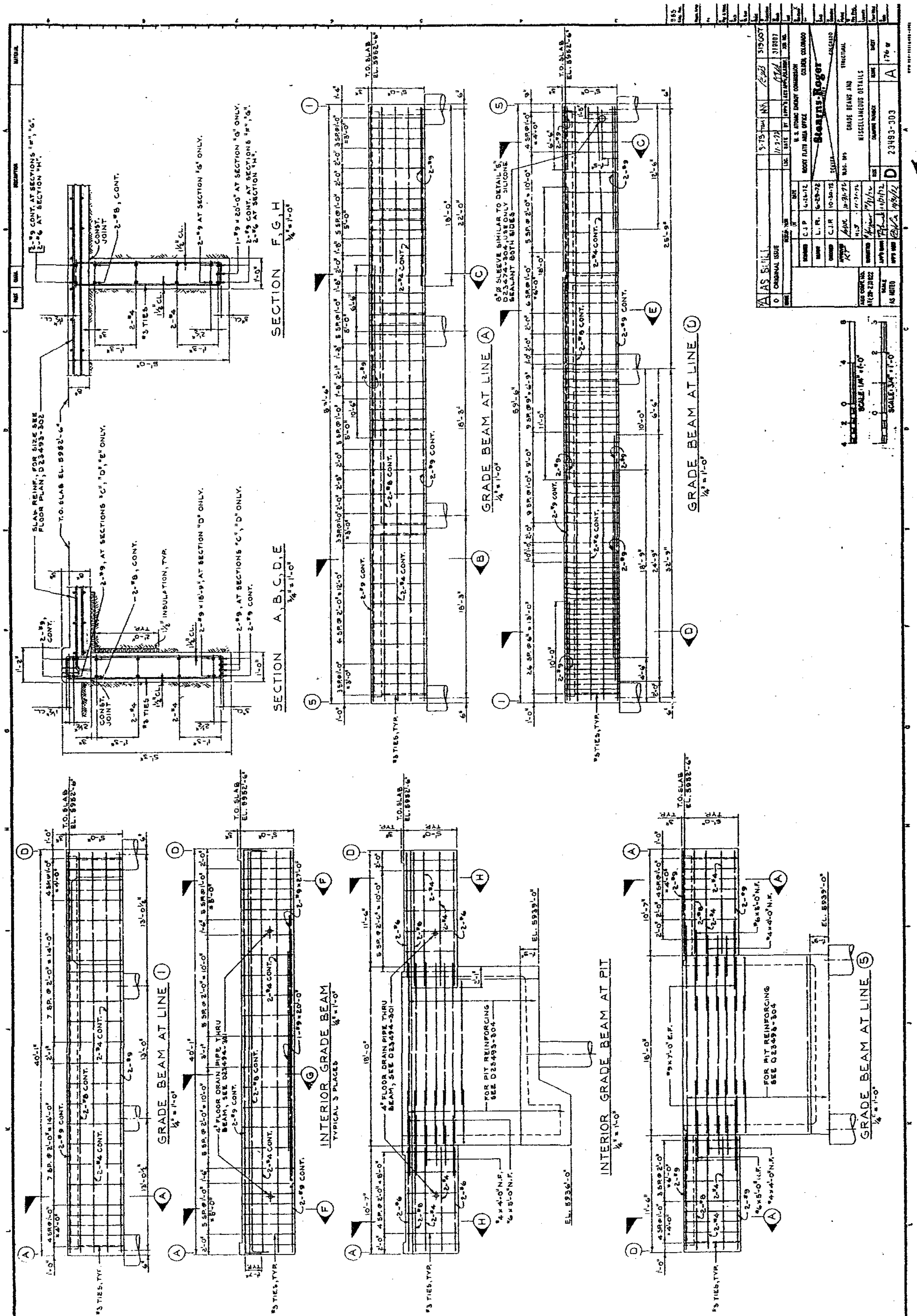
RFETS DWG. No. 13812-0007



B985 FOUNDATION 23493-301

B985 FOUNDATION WILL STAY AND BE COVERED WITH SOIL OVERBURDEN

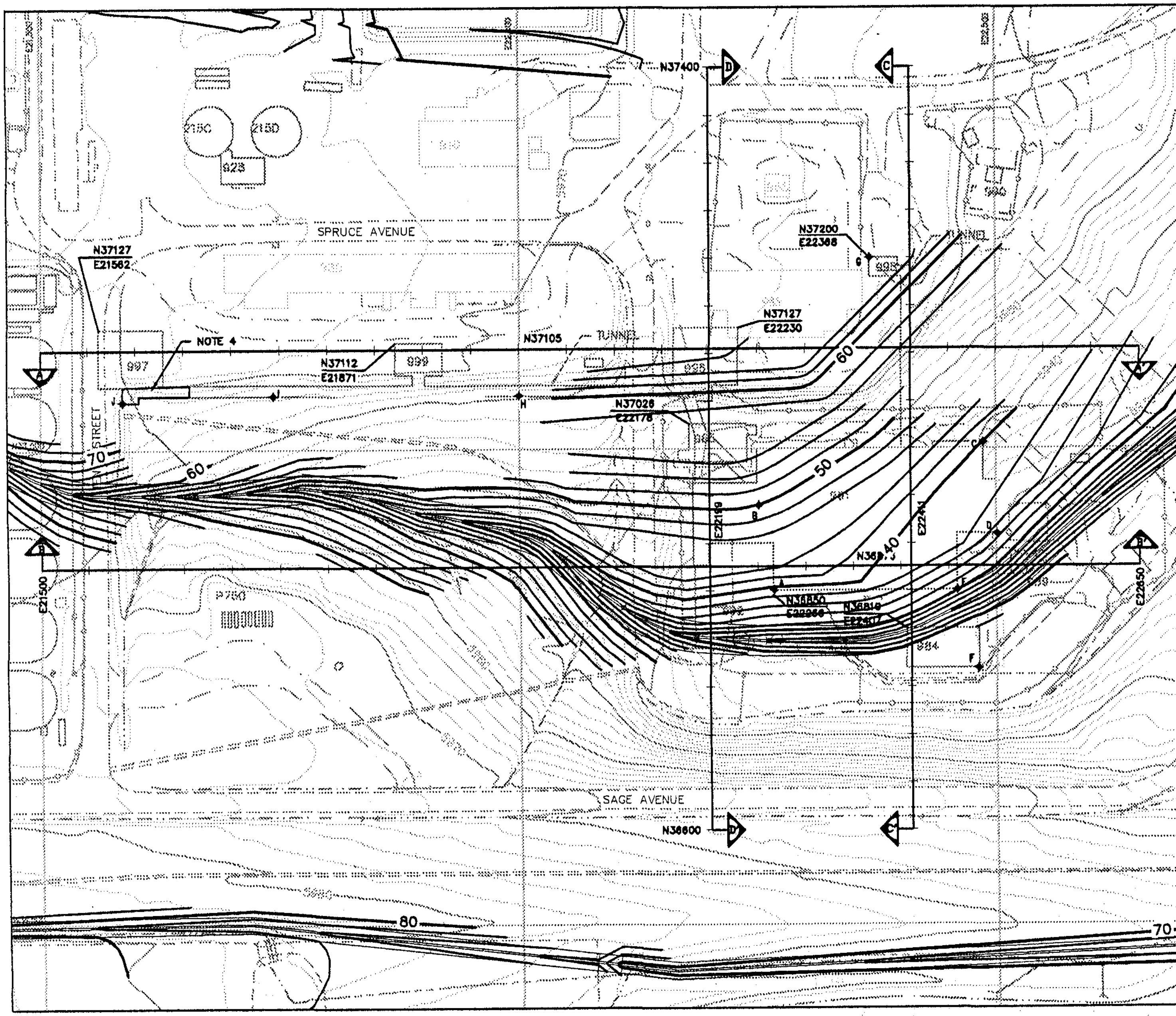
89



B985 FOUNDATION SECTIONS

23493-303

91



PROPOSED LCDB GRADE AT SELECTED BUILDING COLUMN LOCATIONS

POINT	BLDG	COLUMN	EAST	NORTH	LCDB GRADE ELEVATION
A	991	A-2	22,267	36,851	5939.5
B	991	E-1	22,251	36,940	5950.0
C	991	----	22,467	37,006	5940.0
D	991	----	22,501	36,910	5934.8
E	991	A-10	22,459	36,851	5930.4
F	984	----	22,481	36,769	EXISTING
G	998	----	22,368	37,200	EXISTING
H	TUNNEL	----	22,000	37,087	EXISTING
I	TUNNEL	----	21,744	37,087	EXISTING
J	TUNNEL	----	21,587	37,081	5969.4

NOTES:

1. PLAN AND SECTION DRAWINGS ARE NOT INTENDED TO REPRESENT AS-BUILT CONDITIONS, BUT TO PROVIDE A GENERAL GRAPHICAL DEPICTION OF THE RELATIONSHIP BETWEEN SIGNIFICANT STRUCTURAL BUILDING COMPONENTS AND SUBSURFACE FEATURES WITH RESPECT TO EXISTING AND PROPOSED FINAL GRADE PRESENTED IN THE LCDB GRADING AND DRAINAGE CONCEPT. (SEE DRAWING 51754-C001 FOR DRAWING LIST).
2. BUILDING SECTION INFORMATION WAS BASED ON THE FOLLOWING DRAWINGS AND HAS NOT BEEN FIELD VERIFIED.

00A05-0001M, REV B	03743-0001	28738-0104, REV C
00A06-0001M, REV B	03844-0001	28738-0105, REV B
00A07-0001J, REV C	13812-0003, REV B	28738-0106, REV B
00S10-0001B, REV C	13812-0004, REV B	28738-0112, REV C
00S11-0001C, REV D	14391-0003	30991-0001, REV C
00S12-0001C, REV B	17701-0002, REV 2	30991-0004, REV J
00S14-0001C, REV C	17702-0004, REV 1	37179-0101, REV B
00S01-001Y, REV C	28738-0101, REV B	51640-0203, REV 0
00S02-001R, REV C		

3. INTERNAL BUILDING WALLS, BEAMS, GIRDERS, EQUIPMENT PADS, AND OTHER MINOR STRUCTURAL FEATURES ARE NOT SHOWN ON SECTION VIEWS (DRAWINGS 51754-C131 AND 51754-C132) FOR CLARITY. BUILDING COLUMNS AND FLOORS ARE REPRESENTATIVE. DASHED FEATURES ARE PROJECTED VIEWS FROM SECTION CUT. SEE ABOVE DRAWINGS FOR SPECIFIC DIMENSIONS AND LOCATIONS.
4. AN ADDITIONAL 18" THICK LAYER OF CONCRETE WAS PLACED OVER ORIGINAL TUNNEL FOR WATERPROOFING. (SEE DRAWING 1-3743-97).
5. COORDINATES ARE PER AS-BUILT DRAWINGS FOR OUTSIDE BUILDING CORNERS.
6. FILL REQUIRED FOR BUILDINGS 985 AND 991 IS ESTIMATED TO BE APPROX. xx,000 CY. (INCLUDES FILLING OF B991 UTILITY TUNNELS). ESTIMATE DOES NOT INCLUDE VOLUME (APPROX. 5,050 CY) OF UG VAULTS (B996, 997, 998, AND 999) AND CONNECTING TUNNELS. ESTIMATE DOES NOT INCLUDE REPLACEMENT FILL FOR UNDER BUILDING CONTAMINATED SOIL, VOIDS, OR REMOVAL OF OTHER SUBSURFACE MATERIALS. VOLUME OF CONCRETE CONTAINED IN BUILDING 991 IS ESTIMATED TO BE 3,500 CY (INCLUDES ABOVE GRADE COMPONENTS, AND INTERIOR SLABS, COLUMNS, BEAMS, AND GIRDERS).

LEGEND:

EXISTING INDEX CONTOUR
EXISTING 2 FOOT CONTOUR
EXISTING SPOT ELEVATION
PAVED ROAD
UNPAVED ROAD
EXISTING CULVERT
PROPOSED CULVERT
PROPOSED LCDB INDEX CONTOUR
PROPOSED LCDB 2 FOOT CONTOUR
X 85.2 PROPOSED LCDB SPOT ELEVATION
EXISTING DRAINAGE DITCH/CREEK
PROPOSED DRAINAGE DITCH/SWALE
FENCE
CONCRETE

ORIGINAL SCALE: 1"=40'
CONTOUR INTERVAL 2'
ROCKY FLATS COORDINATES

2 REVISED PROPOSED LCDB GRADE (XREF-IA-GRADING-REV6)
PARSONS
KH900286-018
0 ORIGINAL ISSUE/CONCEPTUAL DESIGN
KH900286-003

KEYWORDS: 1.LAND 2.CONFIGURATION 3.GRADING 4.DRAINAGE
991

PARSONS
K. MARTIN KAM 9-30-02
R. SOLBERG RCS 9-30-02
R. STEGEN RLS 9-30-02
S. CUNNINGHAM SLC 9-30-02
N/A
N/A
AS NOTED

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

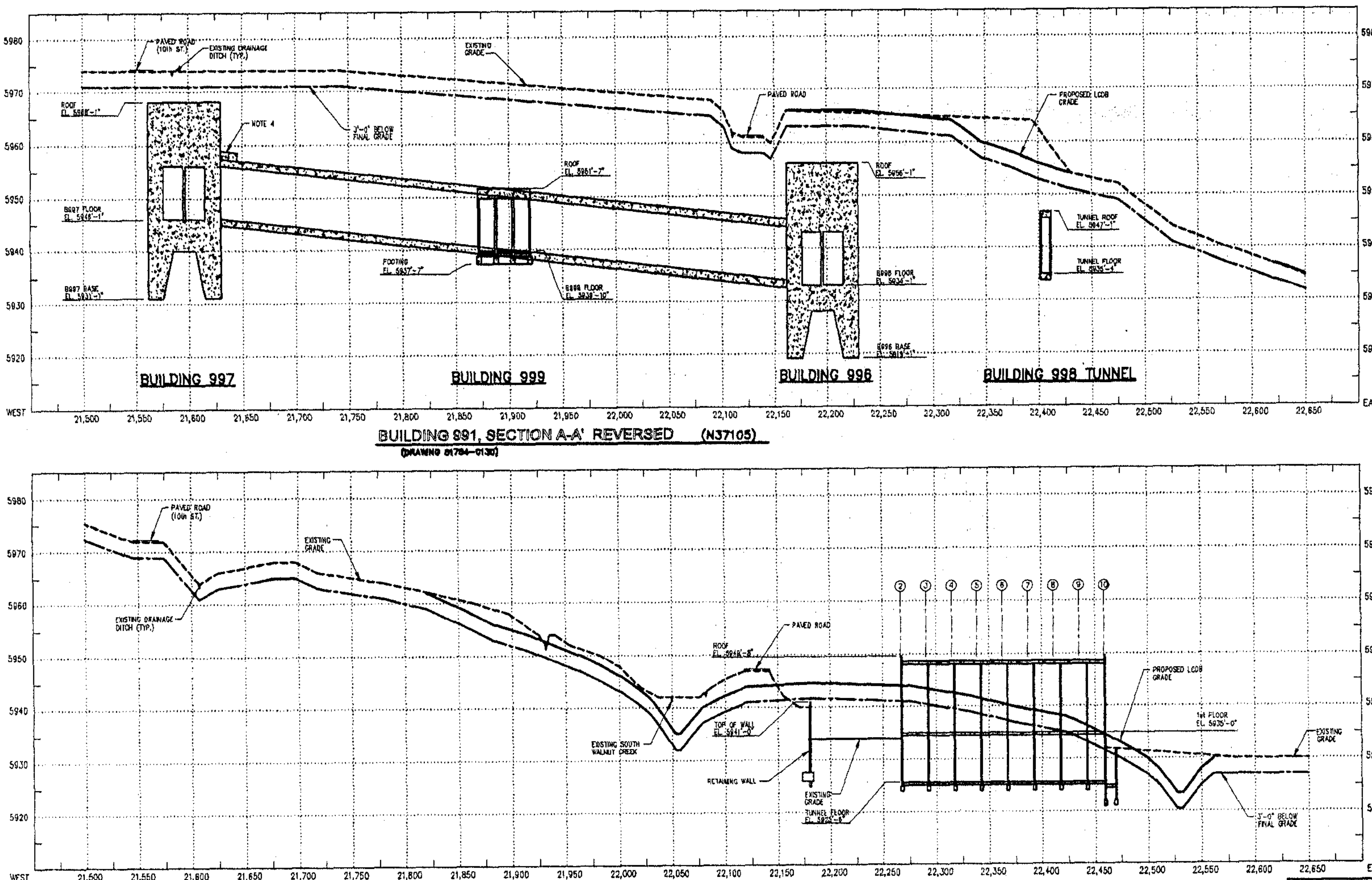
LAND CONFIGURATION DESIGN BASIS
IA GRADING AND DRAINAGE CONCEPT
BUILDING 991
PLAN VIEW

D 51754-C130 2

AUTOCAD COMPUTER GENERATED
NO MANUAL CHANGES ALLOWED

CALC-991-BS-000041

FINAL GRADE DRAWING 51754-C130 (PAGE 29 OF 31)



BUILDING 991, SECTION A-A' REVERSED (N37105)
(DRAWING 51754-C130)

BUILDING 991, SECTION B-B' (COLUMN LINE 8 – N36676)
(DRAWING 51754-C130)

NOTES:

1. SEE DRAWING 51754-C130 FOR GENERAL NOTES.
2. VERTICAL SCALE HAS BEEN EXAGGERATED.
3. SECTION B-B' DOES NOT INCLUDE BUILDING 998.
4. AN ADDITIONAL 18" THICK LAYER OF CONCRETE WAS PLACED OVER ORIGINAL TUNNEL FOR WATERPROOFING. (SEE DRAWING 1-3743-97).

2 REVISED PROPOSED LCDB GRADE (XREF-IA-GRADING-REV8) — PARSONS — KH900286-018
0 ORIGINAL ISSUE/CONCEPTUAL DESIGN — KH900286-003

KEYWORDS: 1.LAND 2.CONFIGURATION 3.GRADING 4.DRAINAGE

K. MARTIN KAM 10-30-02
M. GARCIA MG 10-30-02
R. STEGEN RLS 10-30-02
S. CUNNINGHAM S.C 10-30-02

U.S. DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LAND CONFIGURATION DESIGN BASIS
IA GRADING AND DRAINAGE CONCEPT
BUILDING 991
SECTIONS "AA" AND "BB"

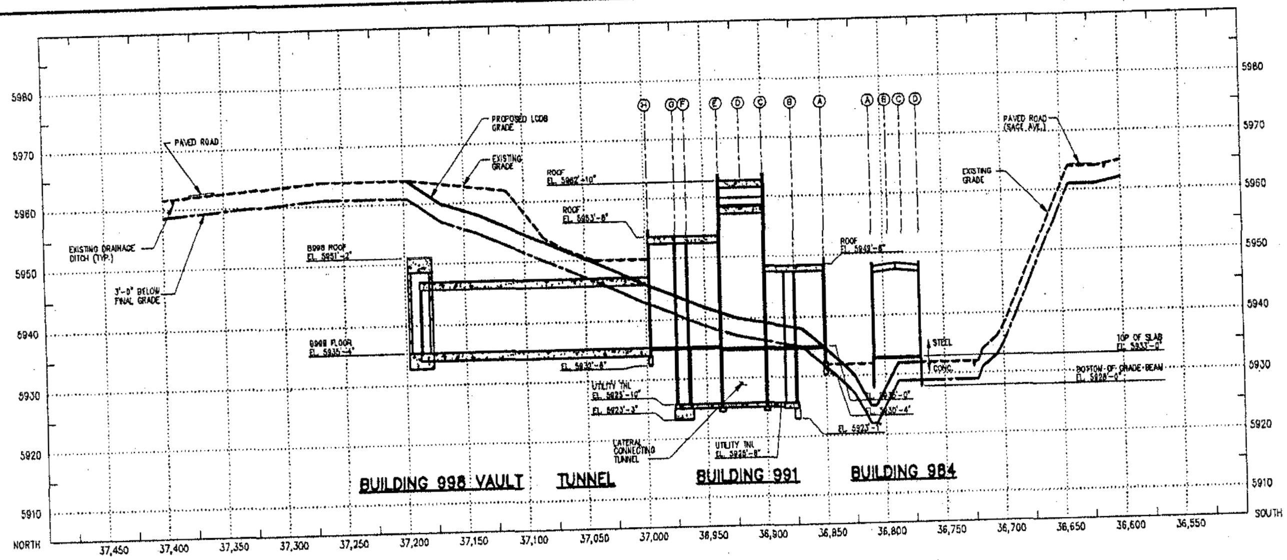
D 51754-C131 2

N/A — AS NOTED

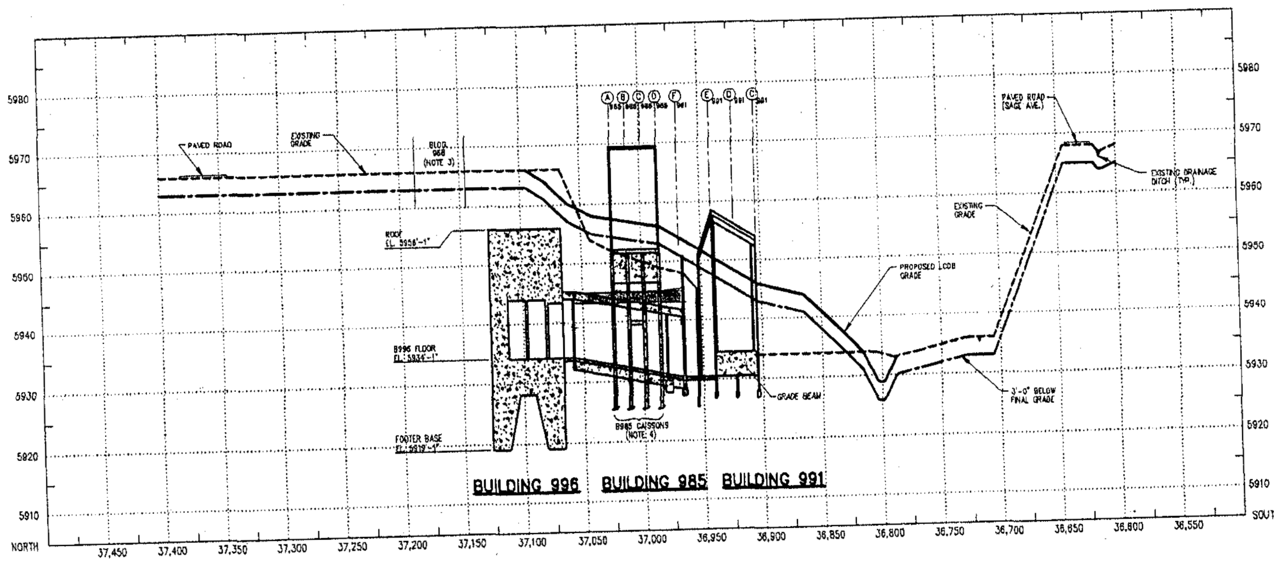
AUTOCAD COMPUTER GENERATED
NO MANUAL CHANGES ALLOWED

CALC-991-BS-000041 FINAL GRADE DRAWING 51754-C131 (PAGE 30 OF 31)

93



BUILDING 991, SECTION C-C' REVERSED (COLUMN LINE 8 – E22,411)
(DRAWING 51754-C130)



BUILDING 991, SECTION D-D' (COLUMN LINE 3W – E22,199)
(DRAWING 51754-C130)

NOTES:

1. SEE DRAWING 51754-C130 FOR GENERAL NOTES.
2. VERTICAL SCALE HAS BEEN EXAGGERATED.
3. SECTION D-D' DOES NOT INCLUDE BUILDING 968.
4. CAISSONS PROJECTED ONTO SECTION C-C' FROM VARIOUS COLUMN LOCATIONS. B985 CONSISTS OF 16 CAISSONS RANGING IN DEPTH FROM 5934'-6" TO 5913'-6".

VERTICAL SCALE 0 10 20
ORIGINAL SCALE 1"=10'

HORIZONTAL SCALE 0 50 100
ORIGINAL SCALE 1"=50'
ROCKY FLATS COORDINATES

2 REVISED PROPOSED LCDB GRADE (XREF-IA-GRADING-REV6)
0 ORIGINAL ISSUE/CONCEPTUAL DESIGN
PARSONS
KEYWORDS: 1.LAND 2.CONFIGURATION 3.GRADING 4.DRAINAGE
K. MARTIN KAM 10-30-02
B. SOLBERG BES 10-30-02
B. STEGEN BLS 10-30-02
S. CUNNINGHAM SLC 10-30-02
991
N/A
N/A
AS NOTED
KH900286-018
KH900286-003
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO
LAND CONFIGURATION DESIGN BASIS
IA GRADING AND DRAINAGE CONCEPT
BUILDING 991
SECTIONS "CC" AND "DD"
D 51754-C132 2

AUTOCAD COMPUTER GENERATED
NO MANUAL CHANGES ALLOWED
Plot date: Sep 18, 2003 - 8:05am

CALC-991-BS-000041 FINAL GRADE DRAWING 51754-C132 (PAGE 31 OF 31)

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 4
Groundwater Modeling Results

Attachment
(Bob Prucha, 12/29/2003)

Results of Building 991 and 998 Vault Modeling Simulations

An analysis of the integrated hydrologic and contaminant transport response to the proposed closure configuration associated with Building 991 and the 998 Vault is presented here. Specifically, two concerns raised by the CDPHE are evaluated. The first concern is whether groundwater levels buildup behind subsurface structures (slabs or walls) left in place. Buildup of groundwater levels behind structures in hillslope areas and possible resulting seep areas may increase the potential for slumping and erosion. The second concern is whether VOCs detected in groundwater to the north, migrate into the Building 991 area. Both of these concerns are evaluated using a localized, high-resolution integrated flow model that includes the area associated with Building 991 and the 998 Vault. Conservative conditions are specified within the modeled system to help identify areas that produce the shallowest groundwater levels that may increase the potential for slumping and erosion.

A uniform 25-foot grid resolution was used to simulate the saturated, unsaturated and overland flow processes in the integrated model. Although, surface channel flow was not explicitly simulated in the model, it does not impact the hydrologic conditions within the 991 building area, and an appropriate set of overland flow (non-channelized) and saturated zone boundary conditions could be specified instead. The finer grid resolution permits explicit definition of the Corridor C Tunnel and Vaults 996, 997 and 999. In addition, the integrated model also includes a specific numerical description of the remaining portion of walls and slab for the 991 Building, 998 Vault, and Buildings 984 and 985.

The specific closure configuration for the 991 Building structures and modification to the soil, vegetation and the regraded surface topography were provided by the ER group. For example, the entire subsurface structure associated with Building 984 was assumed removed for closure, while the 991 Tunnel, Vaults 996, 997 and 999, and the 998 Vault were to be left in place. Only those portions of basement walls and slabs Buildings 985 and 991 remaining at least 3 feet below the regraded topographic surface provided by ER remain as well. Remaining portions of buildings 985 and 991 were included in the model to evaluate the collective impact of all structures left in place on the hydraulics surrounding the 991 Tunnel structures.

Hydraulic conditions surrounding the Tunnel system were evaluated using conservative conditions. In other words, any conditions that cause the shallowest groundwater levels in the area were considered. The two primary conservative conditions considered included assuming a wet year climate and that current drains in the area do not operate. The wet year climate is estimated from a 100-year climate sequence as described in the SWWB modeling report (KH, 2002). Current drains including storm, sanitary and footing drains, that lower groundwater levels, were assumed inoperable. The Tunnel structures were assumed to have a low hydraulic conductivity (1e-10 m/s) to simulate the effect of likely leakage through joints and cracks in the concrete.

For each integrated model run, two typical climate years (WY2000) followed by a wet year were simulated. This sequence allows the groundwater system to stabilize to specified initial conditions before responding to a wet year climate sequence. The integrated model runs produce groundwater levels in all model layers and cells continuously (hourly). The simulated mean and minimum annual groundwater levels for the wet year are used to identify areas of the site where groundwater levels are shallow.

Results show that both the mean and minimum annual groundwater depths during the wet year are at least 3 to 4 meters in the vicinity of Building 991 and 998 vault. This is mostly due to the presence of Arapahoe Sandstone and increased depth to bedrock in the area. Groundwater levels over the remaining Building 991 slab also remain greater than 1 meter depth. For average annual conditions, groundwater intercepts the groundsurface along a portion of South Walnut Creek just below Building 991, but is caused by shallow bedrock in this area. For large precipitation events during the wet year, groundwater intercepts ground surface along a greater extent of South Walnut, and north of the 991 Building area near the former Solar Ponds. Transport simulations showed that VOC plume movement from the north into the Building 991 area does not occur, due to the local northerly flow direction in the plume area.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Hydraulic Impacts of Decommissioning Building 991 and Tunnel 998

KAISER-HILL COMPANY, LLC

Overview

- Model Development
- Conservative Closure Conditions
  - Wet Year Climate
  - No Footing Drains
- Transport Simulation
- Conclusions
- Recommendations

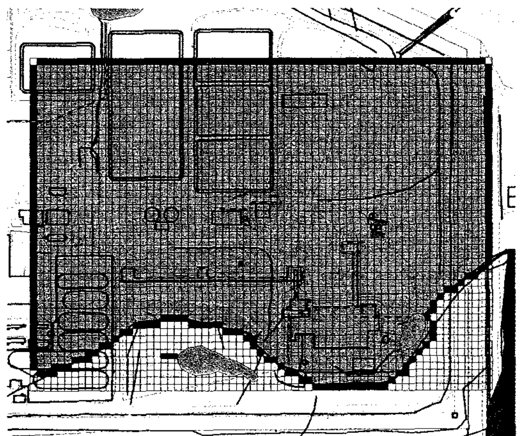
KAISER-HILL COMPANY, LLC

96

Refined Integrated Hydrologic Model
Building 991

- Fully integrated, surface, subsurface flow model
- 25 foot grid consistent with Bldg771 model
- 7-layer Saturated Zone model

Refined grid allows explicit definition of subsurface 991 tunnel and buildings

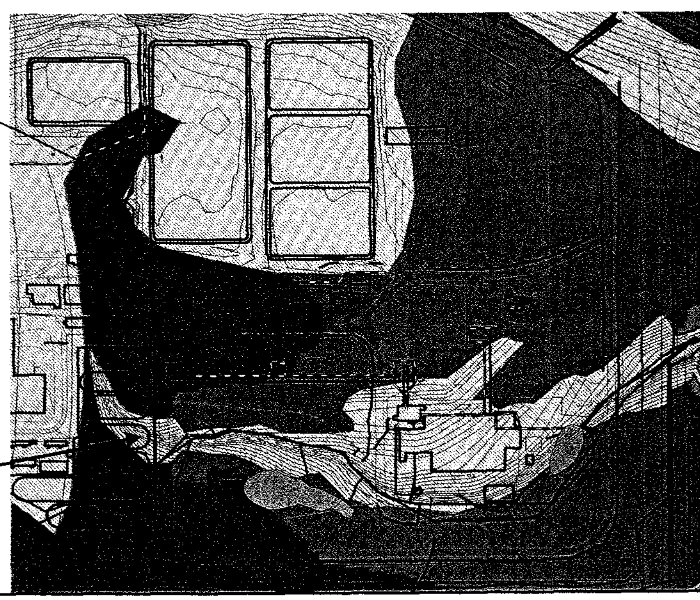


KAISER-HILL COMPANY, LLC

Regraded Area

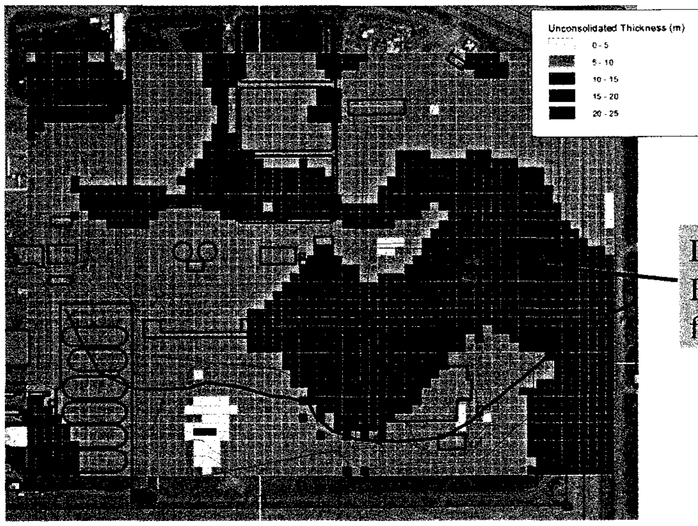
No change in topography (green areas)

Regraded areas shown in white with contours



97

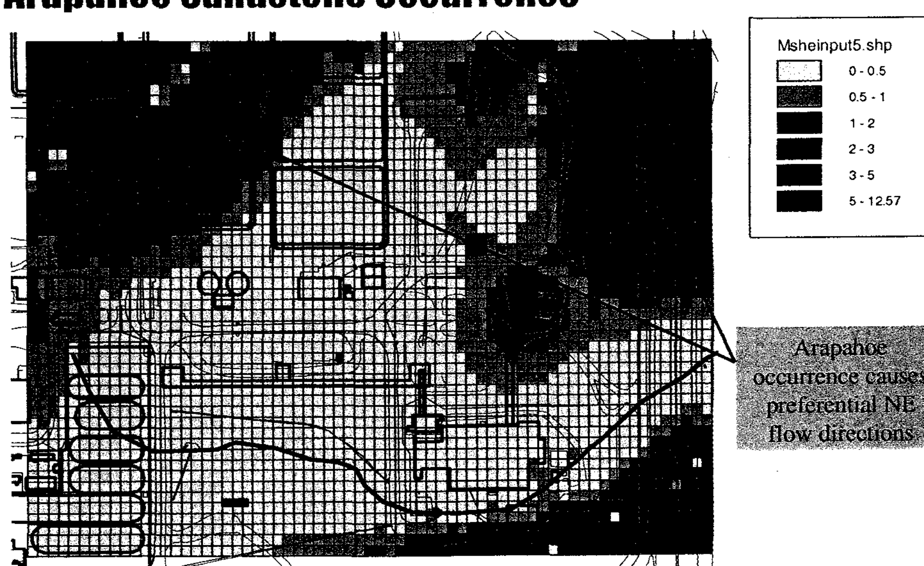
Depth to Weathered Bedrock (ft)



Depth to Bedrock 15-25 feet.

KAISER-HILL COMPANY, LLC

Arapahoe Sandstone Occurrence

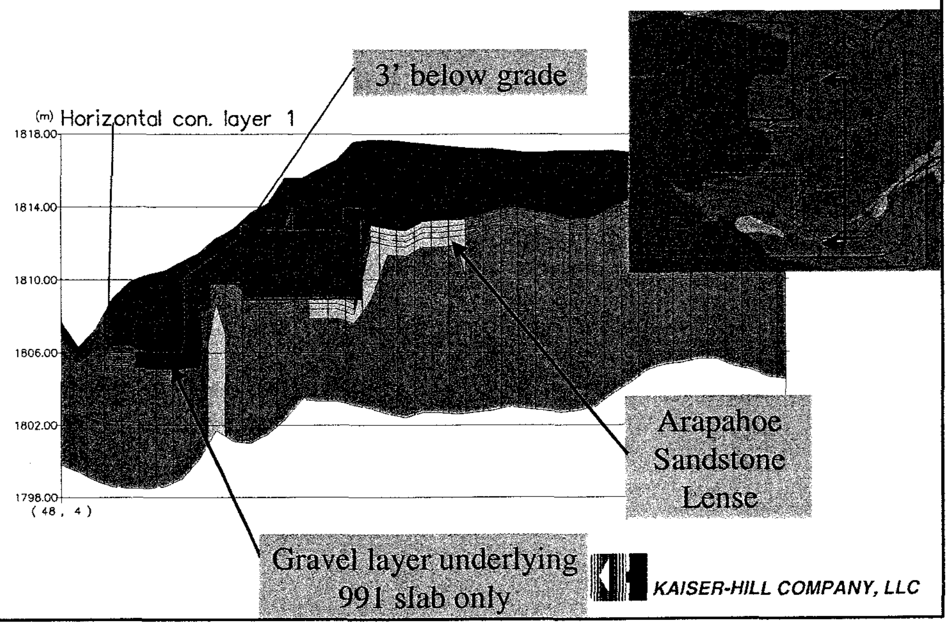


Arapahoe occurrence causes preferential NE flow directions

KAISER-HILL COMPANY, LLC

98

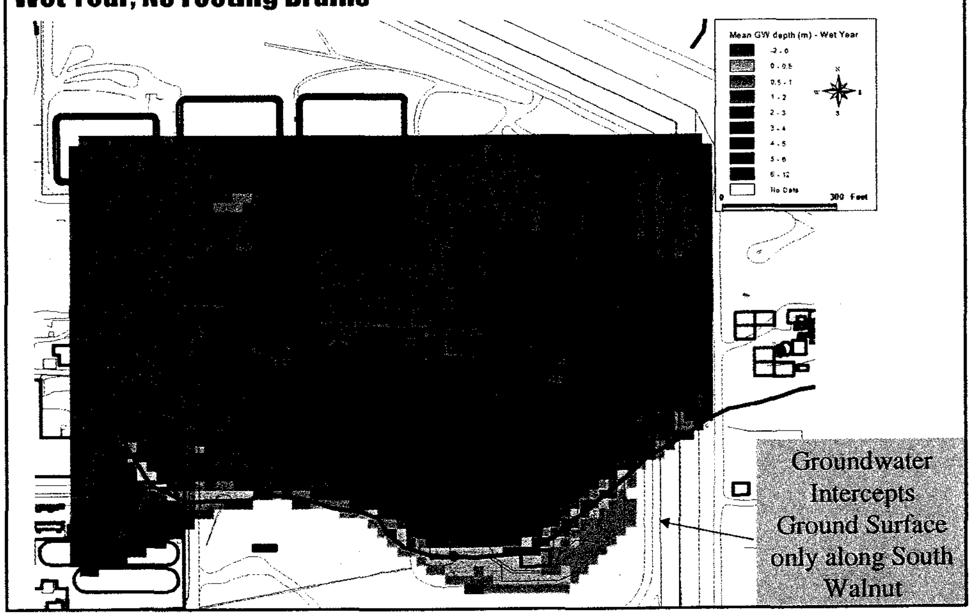
Section through 998 and Building 991



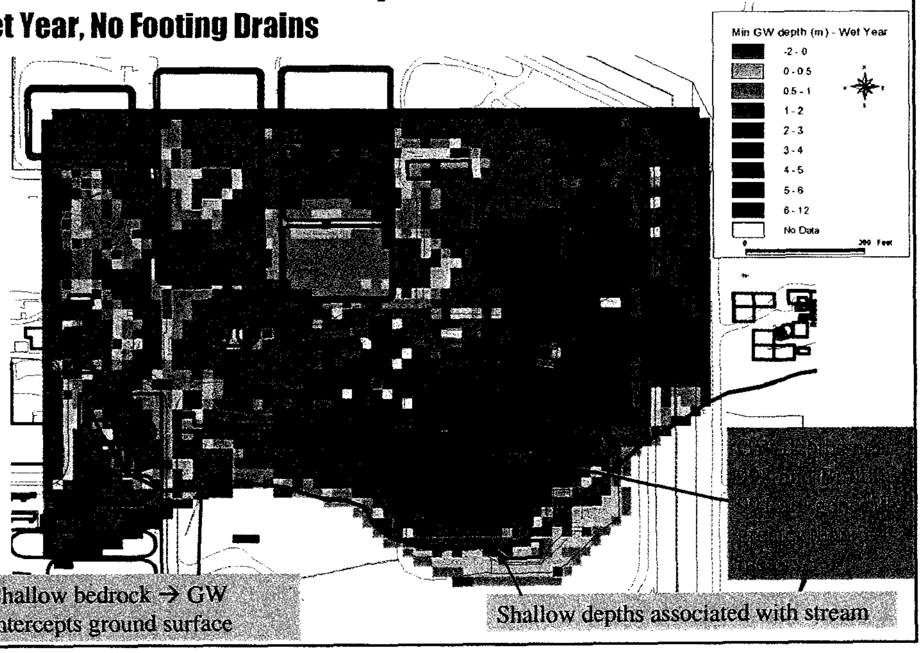
KAISER-HILL COMPANY, LLC

Mean Annual Groundwater Depth (m)

Wet Year, No Footing Drains

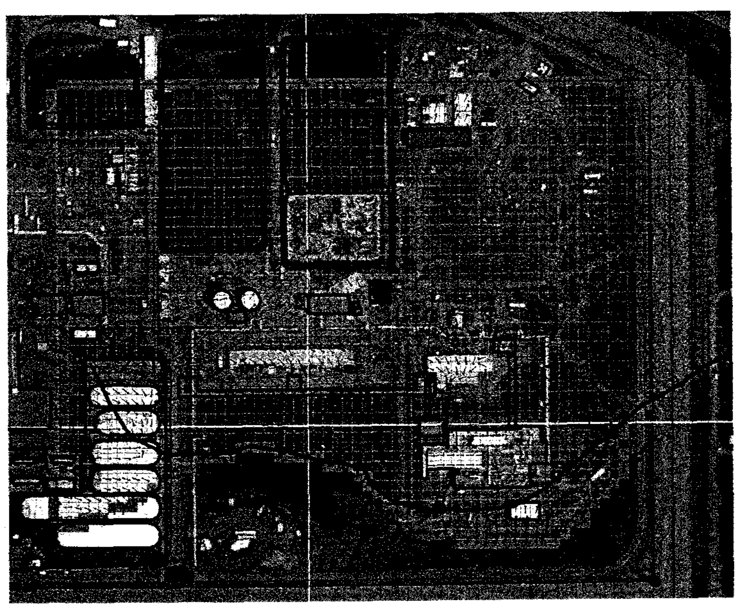


Minimum Annual GW Depths
Wet Year, No Footing Drains



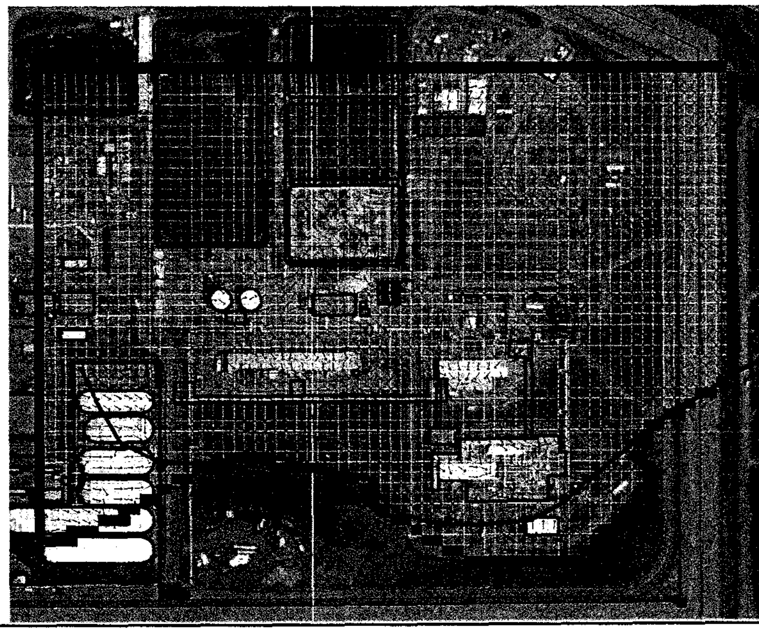
Simulated - Groundwater Flow Directions
Layer 2

Flow arrows do not indicate magnitude



Simulated - Groundwater Flow Directions

Layer 6



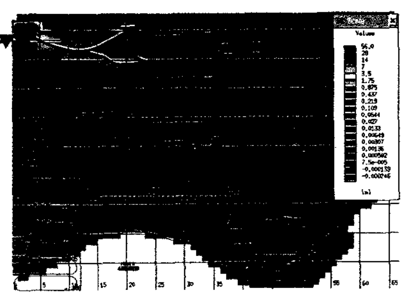
Flow arrows do not indicate magnitude

Transport Simulations

Closure Scenario - Wet Year, No Footing Drains

[illegible]

[illegible]



[illegible]

VOC – Closure Condition – after 200 Years

KAISER-HILL COMPANY, LLC

Conclusions

Conservative Conditions – Wet Year, No Footing Drains

- Groundwater Depths
  - Mean Annual Depths –
    - > 3 to 4 meters below surface around 998 and Building 991
    - Groundwater is shallow at/adjacent to South Walnut Creek just south of Building 991
  - Minimum Annual Depths
    - Still >3 to 4 m below surface around 998 and Building 991
    - More areas within model area exhibit shallow groundwater
- Transport modeling shows (after 200 years) northern VOC plume migrates east and north → no impacts in 991 area
- Vegetation response in wet year → groundwater levels may be lower

KAISER-HILL COMPANY, LLC

Recommendations

- Proposed topographic surface regrade is fine
- Proposed slab/walls associated subsurface building 991 and Tunnel 998 are fine

KAISER-HILL COMPANY, LLC

991 TUNNEL (VAULT 998) RSOP NOTIFICATION FOR FACILITY DISPOSITION

Attachment 5
CERCLA Administrative Record Index

104

998 FILE

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
CERCLA ADMINISTRATIVE RECORD - GENERAL QUERY

There are 21 records in this set and a total of 339 pages.

Doc. No. / Date	Routine	Internal Code	Title / Subject
IA A 000935 04/17/2002 2 Pages PUBLIC	YES, ROUTINE Author(s) GUTHRIE, C. "VERN"	N/A Recipient(s) KRUCHEK, DAVID	Purpose of Contact: To present and discuss the proposed characterization actions for the Building 991 Complex. The facilities included are B991, 991 Tunnels, 984, 985, 989, 992, 993, 996, 997, 998 and 999.
IA A 001239 01/09/2003 1 Pages PUBLIC	YES, ROUTINE Author(s) BUTLER, J. LANE	03-RF-00034; JLB-005-03 Recipient(s) DISALVO, RICHARD	Submits the attached [001240, 001241] Draft Industrial Area Sampling and Analysis Plan (IASAP) FY03 Addendum No. IA-03-03, IHSS Group 900-1 dated December 2002. This also includes the Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Routine Soil Remediation FY02 Notification No. 03-05, IHSS Group 900-1 dated January 2003.
IA A 001240 12/01/2002 17 Pages PUBLIC	YES, ROUTINE Author(s) NOT INDICATED	Ref: 03-RF-00034; JLB-005-03 Recipient(s) DISTRIBUTION	Draft Industrial Area Sampling and Analysis Plan (IASAP) FY03 Addendum No. IA-03-03, Individual Hazardous Substance Site IHSS Group 900-1. The 900-1 Group consists of Under Building Contaminant (UBC) 991, Weapons Assembly and R&D (including Vault Buildings 996, 997, 998 and 999, and assembly tunnels). Also in Group 900-1 are Radioactive Site Buildings 991, IHSS 900-173, Steam Cleaning Area 900-184, Enclosed Area PAC 900-1301 and Explosive Bonding Pit PAC 900-1307, Building 993.
IA A 001241 01/01/2003 12 Pages PUBLIC	YES, ROUTINE Author(s) NOT INDICATED	Ref: 03-RF-00034; JLB-005-03 Recipient(s) DISTRIBUTION	Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Routine Soil Remediation FY02 Notification No. 03-05, Individual Hazardous Substance Site IHSS Group 900-1, January 2003. The 900-1 Group consists of Under Building Contaminant (UBC) 991, Weapons Assembly and R&D (including Vault Buildings 996, 997, 998 and 999, and assembly tunnels). Also in Group 900-1 are Radioactive Site Buildings 991, IHSS 900-173, Steam Cleaning Area 900-184, Enclosed Area PAC 900-1301 and Explosive Bonding Pit PAC 900-

105

There are 21 records in this set and a total of 339 pages.

Doc. No. / Date	Routine	Internal Code	Author(s)	Recipient(s)	Title / Subject
IA A 001242 01/08/2003 1 Pages PUBLIC	YES, ROUTINE	03-RF-00024; JLB-004-03	BUTLER, J. LANE	DISALVO, RICHARD	Submits the attached [001241] Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Routine Soil Remediation FY02 Notification No. 03-05, Individual Hazardous Substance Site IHSS Group 900-1 for review.
IA A 001253 01/21/2003 1 Pages PUBLIC	YES, ROUTINE	03-DOE-00048; 00027-RF-03	DISALVO, RICHARD	GUNDERSON, STEVE	Forwards the attached [001240, 001241] Draft Industrial Area Sampling and Analysis Plan (IASAP) FY03 Addendum No. IA-03-03, IHSS Group 900-1 dated December 2002. This also includes the Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Routine Soil Remediation FY02 Notification No. 03-05, IHSS Group 900-1 dated January 2003.
IA A 001267 01/30/2003 2 Pages PUBLIC	YES, ROUTINE	00093-RF-03	GUNDERSON, STEVE	DISALVO, RICHARD	The Colorado Department of Public Health and Environment (CDPHE) approves the Draft Industrial Area Sampling and Analysis Plan (IASAP) FY03 Addendum No. IA-03-03, Individual Hazardous Substance Site IHSS Group 900-1 and the Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) FY02 Notification No. 03-05 IHSS Group 900-1.
IA A 001269 02/04/2003 1 Pages PUBLIC	YES, ROUTINE	03-DOE-00065; 00086-RF-03	DISALVO, RICHARD	GUNDERSON, STEVE	Forwards the attached [001505] Reconnaissance Level Characterization Report (RLCR) for Building 991 and the Building 991Tunnels 985, 996, 997, 998 and 999, Revision 1 dated January 14, 2003 for approval. Theses buildings are characterized as Type 1 facilities with the exception of Building 991, which is characterized as a lightly contaminated Type 2 facility in accordance with the Decommissioning Program Plan (DPP).

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
CERCLA ADMINISTRATIVE RECORD - GENERAL QUERY

There are 21 records in this set and a total of 339 pages.

Doc. No. / Date	Routine	Internal Code	Title / Subject
IA A 001290 02/01/2003 20 Pages PUBLIC	YES, ROUTINE Author(s) RISS, D&D GROUP	Ref: 02-RF-00336; JLB-014-03 Recipient(s) DISTRIBUTION	Final Industrial Area Sampling and Analysis Plan (IASAP) Fiscal Year 2003 Addendum No. IA-03-03 for Individual Hazardous Substance Site IHSS Group 900-1, February 2003. This IASAP Addendum includes IHSS Group-specific information, sampling locations, and Potential Contaminants of Concern (PCOC) for IHSS, Potential Area of Concern (PAC), and Under Building Contamination (UBC) sites proposed for characterization during FY03. This Addendum is a supplement to the IADAP (DOE, 2001) and includes data and proposed sampling locations for IHSS Group 900-1 and associated IHSS, PAC, and UBC sites listed: UBC 991, Weapons Assembly and R&D (including Vault Buildings 996, 997, 998, and 999, and associated tunnels); Radioactive Site Building 991, IHSS 900-173; Radioactive Site 991 Steam Cleaning Area, IHSS 900-184; Building 991 Enclosed Area, PAC 900-1301; and Explosive Bonding Pit, PAC 900-1307 (Building 993).
IA A 001343 03/21/2003 1 Pages PUBLIC	YES, ROUTINE Author(s) GUNDERSON, STEVE	00287-RF-03; Ref: 03-DOE-00065; 00086-RF-03 Recipient(s) DISALVO, RICHARD	The Colorado Department of Public Health and Environment (CDPHE) grants partial approval of the Reconnaissance Level Characterization Report (RLCR) for Building 991 and the Building 991 Tunnels 985, 996, 997, 998 and 999, Revision 1 dated January 14, 2003. Approval is provided for the Building 991 Type 2 facility. The division is however concerned that the other facilities have not been properly investigated to change their status from potential Type 2 to Type 1 facilities. They are not convinced that the Tunnels and storage vaults should be identified as buildings separate from B991. Therefore, the division cannot at this time concur that B985 is a Type 1 facility, or that the 991 Tunnels and Storage Vaults (Buildings) 996, 997, 998 and 999 are Type 1 facilities or uncontaminated areas of B991.

There are 21 records in this set and a total of 339 pages.

Doc. No. / Date	Routine	Internal Code		Title / Subject
IA A 001346	YES, ROUTINE	N/A		Environmental Restoration (ER) Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Routine Soil Remediation FY03 Notification No. 03-05, Individual Hazardous Substance Site IHSS Group 900-1, February 2003. The 900-1 Group consists of Under Building Contaminant (UBC) 991, Weapons Assembly and R&D (including Vault Buildings 996, 997, 998 and 999, and assembly tunnels). Also in Group 900-1 are Radioactive Site Buildings 991, IHSS 900-173, Steam Cleaning Area 900-184, Enclosed Area PAC 900-1301 and Explosive Bonding Pit PAC 900-1307, Building 993.
02/01/2003	Author(s)		Recipient(s)	
15 Pages	NOT INDICATED		DISTRIBUTION	
PUBLIC				
IA A 001504	YES, ROUTINE	03-RF-00072; DWF-001-03		Submits the attached [001505] Reconnaissance Level Characterization Report (RLCR) for Building 991 and the Building 991 Tunnels 985, 996, 997, 998 and 999, Revision 1 dated January 14, 2003 for approval. Theses buildings are characterized as Type 1 facilities with the exception of Building 991, which is characterized as a lightly contaminated Type 2 facility in accordance with the Decommissioning Program Plan (DPP).
01/15/2003	Author(s)		Recipient(s)	
1 Pages	FERRERA, DENNIS W.		TOWER, STEVE	
PUBLIC				
IA A 001505	YES, ROUTINE	Ref: 03-RF-00072; DWF-001-03		Reconnaissance Level Characterization Report (RLCR) Area 2, Group 2 Closure Project 991, 991 Tunnels 985, 996, 997, 998 and 999, Revision 1 dated January 14, 2003 - This report includes the Historical Site Assessment, Radiological and Chemical Characterization Hazards, Physical Hazards, Facility Classification, and Maps.
01/14/2003	Author(s)		Recipient(s)	
244 Pages	NOT INDICATED		DISTRIBUTION	
PUBLIC				
IA A 001617	YES, ROUTINE	03-RF-01344; FEG-026-03		Submits the enclosed draft letter to the Colorado Department of Public Health and Environment (CDPHE) for the Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) Notification of Component Removal, Size Reduction, and Decontamination Activities for Buildings 991 and 998, and RCRA Closure for Units 991.1 and 984.1.
09/05/2003	Author(s)		Recipient(s)	
17 Pages	GIBBS, FRANK E.		LEGARE, JOSEPH A.	
PUBLIC	TOWER, STEVE		KRUCHEK, DAVID	

108

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
CERCLA ADMINISTRATIVE RECORD - GENERAL QUERY

There are 21 records in this set and a total of 339 pages.

Doc. No. / Date	Routine	Internal Code	Title / Subject
IA A 001700 10/17/2003 2 Pages PUBLIC	YES, ROUTINE Author(s) GUNDERSON, STEVE	00977-RF-03 Recipient(s) LEGARE, JOSEPH A.	Notification by Rocky Flats Environmental Technology Site to invoke the Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Facility Component Removal Sizes Reduction and Decontamination Activities for Buildings 984, 991, and 998, including Closure of Permitted Hazardous/ Mixed Waste container Storage

Date and Time	4/17/2002 11:00:00 AM		
Primary Site Contact	Vern Guthrie	Primary Reg Contact	Dave Kruchek
SecondaySite Contact		Seconday Reg Contact	
Unit	Building	Site Phone	Agency
	991	*7419	CDPHE

Purpose

To present and discuss proposed characterization actions for the Building 991 complex.

Discussion

Facilities included: Building 991, 991 Tunnels, 984, 985, 989, 992, 993, 996, 997, 998, and 999. Presentation: Vern Guthrie presented an overview of the purpose of the meeting and provided an area map showing the locations of the Type 1 and 2 buildings as they are currently identified. He explained that characterization activities were planned for this FY, but due to other building priorities, some work may be moved into early FY03. Vern explained that removal of the buildings is scheduled for FY03 and early FY04. Material Stewardship's shipment of waste from Building 991 may push the schedule out, as certain waste may not have a shipping location approved. Duane Parsons provided a packet of characterization information for review and comment. Included were maps identifying buildings within the cluster and Historical Site Assessment Reports for each building. Also included were Radiological Characterizations Plans for the interiors and exteriors of Type 1 and Type 2 facilities and Chemical Characterization Plans for both Type 1 and 2 facilities. A suggestion was made to remove 996, 997, 998, and 999 from the exterior plan as sampling cannot be performed on them. Dave Krucheck was concerned that Beryllium may be in between layers of paint within the tunnels and possibly other areas of Building 991. Duane will address this concern during the Reconnaissance Level Characterization Report. Dave's other concern was with Building 984 being identified as a Type 1 facility. The survey work will verify the typing. Steve Tower expressed the same Beryllium concerns as Dave for buildings on site and what the effects would be during demolition.

Date and Time	7/31/2003 12:00:00 PM		
Primary Site Contact	Karan Wiemelt	Primary Reg Contact	Dave Krucheck
SecondaySite Contact		Seconday Reg Contact	
Unit	Building	Site Phone	Agency
	991 Tunnel		CDPHE

Purpose

991 Tunnel Component Removal

Discussion

An RSOP Notification for Component Removal has been submitted for the ductwork, utilities, and piping removal in the 991 Tunnel (996, 997, and 999 vault area). Since the ductwork, utilities, and piping has been surveyed and found to be clean, K-H requested a verbal approval from CDPHE to begin the removal prior to written approval of the RSOP Notification. Dave Kruchek/CDPHE granted verbal approval to remove the ductwork, utilities, and piping from the 991 Tunnel (996, 997, and 999 vault area).

Date and Time	11/19/2003 2:30:00 PM		
Primary Site Contact	J.R. Marschall	Primary Reg Contact	Dave Krucheck
SecondaySite Contact		Seconday Reg Contact	
Unit	Building	Site Phone	Agency
	991		CDPHE

Purpose

Discuss properties of the foam to be used to plug the 998 Tunnel, Corridor B, and Room 402 in Bldg. 991

Discussion

During the weekly status meeting at RFETS on November 12, Dave Kruchek advised that he was concerned that the foam being used to plug off the tunnels and other rooms in Bldg. 991 would eventually be considerably degraded due to virtually constant immersion in underground water. This was the condition he noted when tanks at RFETS that had been filled with foam some years ago were dug up and the foam found to be waterlogged and severely degraded. A meeting was arranged for Dave with the RFETS foam application contractor, Dick Hogue, and J. R. Marschall, 991 Project Manager. Dick explained that the foam being proposed for the Bldg. 991 jobs was AutoFroth 9453 Foam from BASF Mfg. This foam is a two part, pourable foam system presently being used on site to block and brace cargo containers, and fill air handling ducts and chemical process lines. It was also the foam used to plug the 996 Tunnel in Bldg. 991. The polyurethane chemical composition and closed cell nature of the product render it very stable and it will not be decomposed by long term direct contact with moisture an is not biologically reducible by bacteria, mold, yeast or fungi. Prolonged exposure to the ultra violet rays of the sun provides the only degradation to the product, which takes years of constant exposure and is not an issue with this application. Dave agreed that this foam was structurally superior to the foam used in tanks, but was still concerned about the thickness, 3' to 4', proposed to plug the 998 Tunnel, Corridor B, and Room 402. The foam applied to the 996 Tunnel was held in place by a bank type vault door that would be in place many years before any sign of structural weakness. That is not the case with these recently proposed applications. During the meeting Dick contacted his representative at the BASF factory who agreed that 3' to 4' was probably not sufficient to provide hundreds of years of assurance that the foam plug would remain in tact and suggested that the length of the plug should be at least as long as the plug is high. This was satisfactory to Dave and the parties agreed that the length of the foam plug would be 15% longer than the height in those areas where substantial support is not present on the down gradient side of any foam plug. This process will be used to seal off the two entrances to Corridor B on the west end of Bldg. 991, Room 402 next to Corridor B, and the 998 Tunnel on the east side of Bldg. 991.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
REGULATORY CONTACT RECORD

Date/Time:	January 7, 2004 / 1:00 p.m.		
Site Contact(s):	J.R. Marschall	Gary Morgan	Karen Wiemelt
Phone:	303-966-2372	303-966-6003	303-966-9883
Regulatory Contact:	David Kruchek		
Phone:	303-692-3328		
Agency:	CDPHE		

Purpose of Contact: Agreement to plug the 998 Tunnel (Corridor A), Corridor B, and Room 402 with foam

---

Discussion

At the January 7, 2004, Bi-Weekly D&D Meeting with CDPHE and DOE, K-H personnel made a presentation discussing the effects of leaving the 998 Vault, Corridor A (partial), Corridor B, and Room 402 in place. The presentation consisted of an analysis of the effect on ground water and VOC plume movement during a wet year caused by the structures left in place and a structural analysis on when those structures might be expected to fail. Based of direction of ground water flow and the depth of bedrock in those areas it was determined the structures left in place would have little effect and would not cause slumping and erosion of the topsoil. Transport simulations showed the VOC plume movement from the north into the Building 991 area does not occur, due to the local northerly flow direction in the plume area. The structural analysis showed a high probability that the structures would not fail for up to 1000 years.

Based on these results Dave Kruchek agreed that K-H could proceed with the foaming of Corridor A, Corridor B (2 places), and Room 402 thereby leaving those structures in place after demolition of Building 991. Foam plugs will be placed as follows:

- 998 Tunnel (Corridor A) will be plugged with foam 60' north of the entrance to the tunnel from Building 991. The foam plug will be approximately 8'w. x 10'h. x 12.5'deep. The southern 60' of the tunnel will then be demolished along with Building 991 and be back-filled with compacted soil to the foam plug.
- Corridor B will be plugged with foam in two places; at the roll-up door entering from the courtyard under the canopy, and at the double door on the east end entering from Building 991. The foam plug at the roll-up door will be approximately 10'w. x 12'h. x 18'deep and placed against the roll-up door. The foam plug at the east doors will be approximately 8'w. x 8'h. x 10'deep encompassing the 45^{o} turn, and placed against the double doors. When demolition is complete both entrances will have compacted back-fill up against the doors.
- Room 402 will be plugged with foam at the double door entrance. The foam plug will be approximately 10'w. x 10'h. x 12'deep. The double door is next to the roll-up door in Corridor B and will also have compacted back-fill against it.

112

Contact Record Prepared By: J.R. Marschall

Required Distribution:

M. Aguilar, USEPA
S. Bell, DOE-RFFO
B. Birk, DOE-RFFO
C. Deck, K-H Legal
D. Foss, K-H 707/776/777
C. Gilbreath, K-H 771/774
S. Gunderson, CDPHE
L. Kilpatrick, DOE-RFFO
G. Kleeman, USEPA
J. Legare, DOE-RFFO
R. Leitner, K-H 371/374
D. Maxwell, DOE-RFFO
J. Mead, K-H ESS
S. Nesta, K-H RISS
K. North, K-H ESS/MS
R. Schassburger, DOE-RFFO
D. Shelton, K-H ESS
C. Zahm, K-H Legal

Additional Distribution:

Gary Morgan, DOE-RFFO
Karen Wiemelt, K-H RISS

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
REGULATORY CONTACT RECORD

Date/Time:	February 2, 2004 / 12:00		
Site Contact(s):	J.R. Marschall	Gary Morgan	Karen Wiemelt
Phone:	303-966-2372	303-966-6003	303-966-9883
Regulatory Contact:	Dave Kruchek		
Phone:	303-692-3328		
Agency:	CDPHE		

Purpose of Contact: Agreement to apply foam plugs in Corridor B and Room 402, Building 991.

Discussion

The above parties met on February 2, 2004, to continue discussions on effects of leaving Corridor B and Room 402 in place, and plugging the entrances with foam (reference Contact Record dated January 7). Duane Parsons also attended the meeting and provided preliminary reports that the Pre-Demolition Surveys had been completed in the subject areas with results below free-release limits.

Keith MacLeod, who performed the structural calculations, reported that the east leg of Corridor B with less free span would not collapse for 1000 to 1500 years. The west leg of Corridor B under the Building 985 slab (left in place) would not collapse for at least 700 years. The remaining portion (approximately 20') of the west leg would not support the earthen burden after corrosion of the reinforcing bars and would collapse after a minimum of 500 years. Room 402 with greatest span of the three areas, would also not support the earthen burden after corrosion of the reinforcing bar, and would last a minimum of 500 years. The issue with the collapse of Room 402 is that it was projected to leave a depression some 35' across and 12'-6" deep.

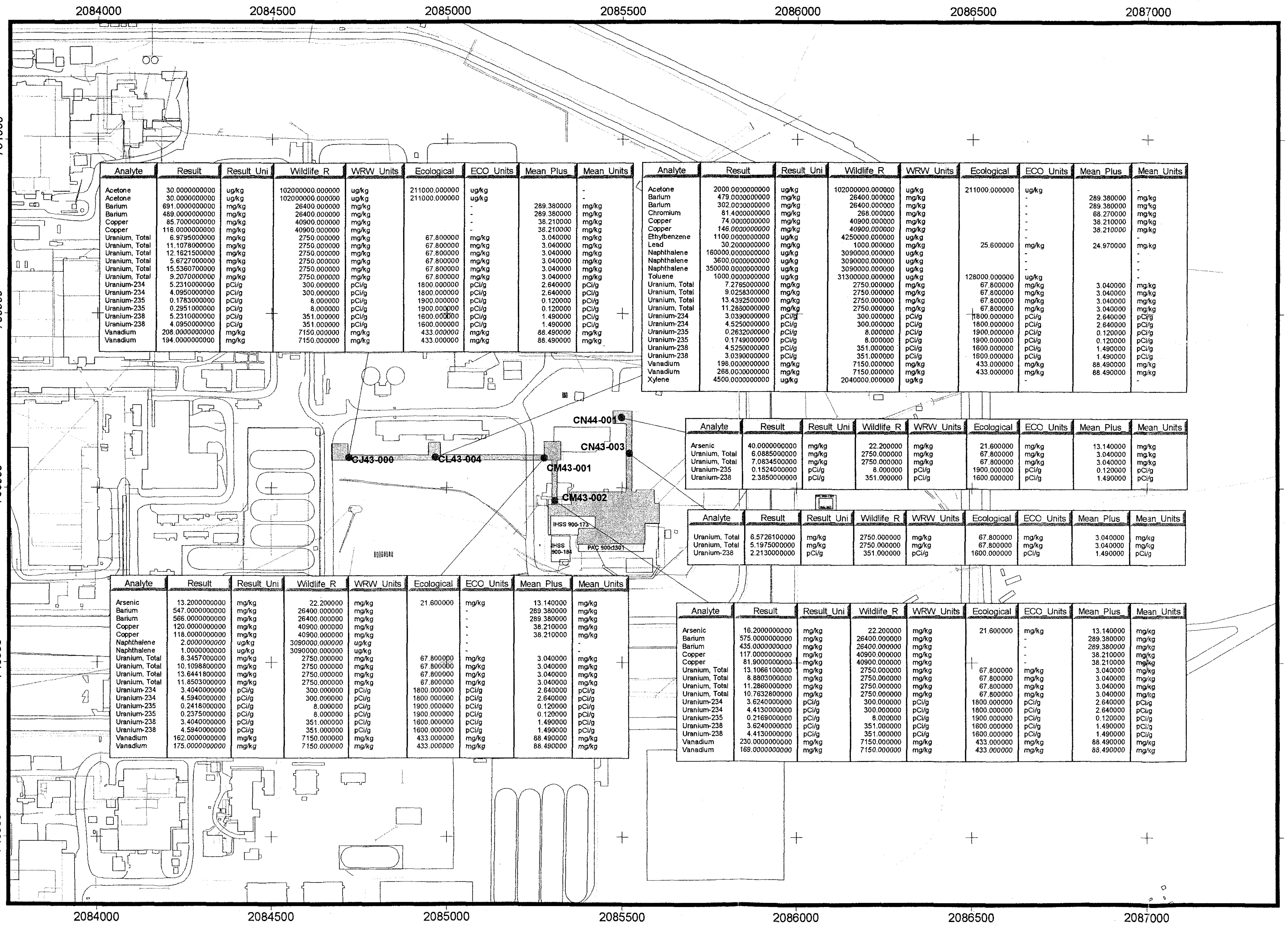
A depression that deep concerned Dave Kruchek and he requested that the depression be minimized somehow. It was decided that Room 402 would be filled to a depth of 6' throughout the room with foam and the entrance plugged completely as discussed in the Contact Record of January 7. This would limit the size of the depression to approximately 6' deep. With a compressive strength of nearly 3500 pounds/cubic foot the foam is not expected to compress much, if at all, with soil and concrete on top of it at 100 and 180 pounds/cubic foot respectively. Dave agreed to this resolution for Room 402 and approved the foam plugs for each end of Corridor B as described in the Contact Record of January 7. Dave also requested and it was agreed that the west end of Corridor B would be allowed to drain off any accumulated water behind the foam plug by making sure the small trough against the west wall would be kept open.

Contact Record Prepared By: J.R. Marschall

Required Distribution:		Additional Distribution:
M. Aguilar, USEPA	J. Legare, DOE-RFFO	
S. Bell, DOE-RFFO	R. Leitner, K-H 371/374	
B. Birk, DOE-RFFO	D. Maxwell, DOE-RFFO	
C. Deck, K-H Legal	J. Mead, K-H ESS	
D. Foss, K-H 707/776/777	S. Nesta, K-H RISS	
C. Gilbreath, K-H 771/774	K. North, K-H ESS/MS	
S. Gunderson, CDPHE	R. Schassburger, DOE-RFFO	
L. Kilpatrick, DOE-RFFO	D. Shelton, K-H ESS	
G. Kleeman, USEPA	C. Zahm, K-H Legal	

In Progress Field Map

Building 991 Tunnel UBC Sampling Location Results Greater Than Background Means Plus Two Standard Deviations or Detection Limits



Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Acetone	30.0000000000	ug/kg	102000000.000000	ug/kg	211000.000000	ug/kg		-
Acetone	30.0000000000	ug/kg	102000000.000000	ug/kg	211000.000000	ug/kg		-
Barium	691.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Barium	489.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Copper	85.7000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Copper	116.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Uranium, Total	6.9795000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	11.1078000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	12.1621500000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	5.6727000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	15.5360700000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	9.2070000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-234	5.2310000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-234	4.0950000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-235	0.1783000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-235	0.2951000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-238	5.2310000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Uranium-238	4.0950000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Vanadium	208.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg
Vanadium	194.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg

Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Acetone	2000.0000000000	ug/kg	102000000.000000	ug/kg	211000.000000	ug/kg		-
Barium	479.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Barium	302.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Chromium	81.4000000000	mg/kg	268.000000	mg/kg		-	68.270000	mg/kg
Copper	74.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Copper	146.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Ethylbenzene	1100.0000000000	ug/kg	4250000.000000	ug/kg		-		-
Lead	30.2000000000	mg/kg	1000.000000	mg/kg	25.600000	mg/kg	24.970000	mg/kg
Naphthalene	160000.0000000000	ug/kg	3090000.000000	ug/kg		-		-
Naphthalene	3600.0000000000	ug/kg	3090000.000000	ug/kg		-		-
Naphthalene	350000.0000000000	ug/kg	3090000.000000	ug/kg		-		-
Toluene	1000.0000000000	ug/kg	31300000.000000	ug/kg	128000.000000	ug/kg		-
Uranium, Total	7.2765000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	9.0258300000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	13.4392500000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	11.2860000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-234	3.0390000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-234	4.5250000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-235	0.2632000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-235	0.1749000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-238	4.5250000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Uranium-238	3.0390000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Vanadium	198.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg
Vanadium	268.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg
Xylene	4500.0000000000	ug/kg	2040000.000000	ug/kg		-		-

Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Arsenic	40.0000000000	mg/kg	22.200000	mg/kg	21.600000	mg/kg	13.140000	mg/kg
Uranium, Total	6.0885000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	7.0834500000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-235	0.1524000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-238	2.3850000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g

Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Uranium, Total	6.5726100000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	5.1975000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-238	2.2130000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g

Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Arsenic	13.2000000000	mg/kg	22.200000	mg/kg	21.600000	mg/kg	13.140000	mg/kg
Barium	547.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Barium	566.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Copper	120.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Copper	118.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Naphthalene	2.0000000000	ug/kg	3090000.000000	ug/kg		-		-
Naphthalene	1.0000000000	ug/kg	3090000.000000	ug/kg		-		-
Uranium, Total	8.3457000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	10.1098800000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	13.6441800000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	11.8503000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-234	3.4040000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-234	4.5940000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-235	0.2418000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-235	0.2375000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-238	3.4040000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Uranium-238	4.5940000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Vanadium	162.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg
Vanadium	175.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg

Analyte	Result	Result_Uni	Wildlife_R	WRW_Units	Ecological	ECO_Units	Mean_Plus	Mean_Units
Arsenic	16.2000000000	mg/kg	22.200000	mg/kg	21.600000	mg/kg	13.140000	mg/kg
Barium	575.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Barium	435.0000000000	mg/kg	26400.000000	mg/kg		-	289.380000	mg/kg
Copper	117.0000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Copper	81.9000000000	mg/kg	40900.000000	mg/kg		-	38.210000	mg/kg
Uranium, Total	13.1066100000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	8.8803000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	11.2860000000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium, Total	10.7632800000	mg/kg	2750.000000	mg/kg	67.800000	mg/kg	3.040000	mg/kg
Uranium-234	3.6240000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-234	4.4130000000	pCi/g	300.000000	pCi/g	1800.000000	pCi/g	2.640000	pCi/g
Uranium-235	0.2169000000	pCi/g	8.000000	pCi/g	1900.000000	pCi/g	0.120000	pCi/g
Uranium-238	3.6240000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Uranium-238	4.4130000000	pCi/g	351.000000	pCi/g	1600.000000	pCi/g	1.490000	pCi/g
Vanadium	230.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg
Vanadium	169.0000000000	mg/kg	7150.000000	mg/kg	433.000000	mg/kg	88.490000	mg/kg

KEY

- Sampling location
- Building
- UBC Site
- IHSS
- PAC
- OPWL
- NPWL
- Foundation drain
- Storm drain
- Stream
- Paved Road

Disclaimer:
Neither the United States Government, Kaiser-Hill, LLC, any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

"PRELIMIARY INFORMATION - SUBJECT TO CHANGE"

N

50 0 50
Feet
Scale = 1:9,063
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Prepared for: KAISER+HILL COMPANY

Date: 01/19/04

File: w:\projects\fy2003\900-1\characterization\900-1_char_gk.apr Layout: D&D In Progress

32